THE RAILWAY GAZETTE
A Journal of Management, Engineering and Operation
INCORPORATING
Railway Engineer · TRANSPORT · The Railway News
The Railway Times · Herapath's Railway Journal · RAILWAY RECORD.
RAILWAYS ILLUSTRATED · ESTABLISHED 1835 · RAILWAY OFFICIAL GAZETTE

PUBLISHED EVERY FRIDAY
AT
33, TOTHILL STREET, WESTMINSTER, LONDON, S.W.1

Telegraphic Address: "TRAZETTE PARL., LONDON"
Telephone No.: VICTORIA 8836 (6 lines)

Annual subscription payable in advance and postage free:
British Isles and Abroad.....£2 5s. 0d.
Single Copies.....One Shilling
Registered at the General Post Office, London, as a Newspaper

VOL. 63. No. 2 FRIDAY, JULY 12, 1935

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DIESEL RAILWAY TRACTION

A Supplement illustrating and describing developments in Diesel Railway Traction is presented with each copy of this week's issue.

Sir Hugh Reid

THE locomotive industry has lost an outstanding personality in the death of Sir Hugh Reid, Bt., C.B.E., V.D., D.L., LL.D., M.Inst.C.E., who even as recently as last week was actively engaged as Chairman and Chief Managing Director of the North British Locomotive Co. Ltd., Glasgow. For nearly 60 years he had been connected with the industry, initially with a thorough grounding which included five years' apprenticeship and varied practical experience in his father's Hyde Park works. Later he was in partnership with his brothers and succeeded his father, Mr. James Reid, as senior partner and played a leading part in the extension of the firm and in its amalgamation with Dubs and Sharp Stewarts to form the North British concern. Sir Hugh's breadth of view in locomotive matters is shown by his belief in the possibility of improving the steam locomotive by the use of the turbine, as in the Reid-Ramsay engine, of which he was builder and part designer and patentee. As head of the largest locomotive building firm in Great Britain, his name is familiar to railway mechanical engineers all over the world and there can be few railways, whatever their gauge, within the Empire upon which at least some of his engines are not or have not at some time been running. His loss as a public benefactor will be greatly felt especially in and around Glasgow.

* * * *

A Contribution to Peace

In an L.M.S. dining car the other evening, one of those torrid summer nights we sometimes have to endure even in England, appetite was whetted by the reading of a menu which promised such toothsome fare as iced grape fruit, turbot Duglere, cold chicken and ham with new potatoes and salad, asparagus, and strawberries. Experience did nothing to mar the fair promise and there ensued a feeling of peace with the world, and a flow of satisfactory thoughts, foremost among which we discovered the way to abolish war. Impossible to want to fight after such a meal, so why not see to it that everyone is equally well catered for in surroundings no less restful and pleasant than a modern L.M.S. dining car? *Why* not? It might put Mr. Anthony Eden out of a job, but then no one would welcome a rest from a difficult task more than Mr. Anthony Eden. One fly there was in the ointment of that pleasant journey: At the bottom of the menu appeared these words: "In the general interest Passengers are requested to refrain from smoking immediately prior to and during the service of meals." This polite request was, of course, heeded by all the Passengers, but there were, unfortunately, one or two passengers among us who didn't. Which raised the reflection that perhaps, after all, war is incurable.

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The Week's Traffics

Traffics of the four group companies for the past week were satisfactory except for small decreases in passenger train earnings on the Great Western and in coal on the Southern. For the 27 weeks of the present year the aggregate takings of the four companies together, show a net increase of £433,000, made up of an increase of £712,000 in passenger train earnings, a net decrease of £96,500 in merchandise receipts, and a net decrease of £182,500 in coal class traffics. All the companies have increases in passenger receipts.

	27th Week				Year to date.	
	Pass., &c.	Goods, &c.	Coal, &c.	Total.	Inc. or dec.	
	£	£	£	£	£	%
L.M.S.R. ..	+ 8,000	+ 18,000	+ 3,000	+ 29,000	+ 328,000	+ 1·09
L.N.E.R. ..	+ 10,000	+ 11,000	+ 2,000	+ 23,000	— 3,000	— 0·014
G.W.R. ..	— 5,000	+ 16,000	+ 6,000	+ 17,000	+ 95,000	+ 0·77
S.R. ..	+ 7,000	+ 500	— 2,500	+ 5,000	+ 13,000	+ 0·13

* * * *

Leopoldina Railway

In the volume of traffic carried the Leopoldina Railway, in 1934, showed a marked improvement in comparison with 1933. The number of passengers was a record, though 87·51 per cent. of them were in the suburban area where the fares were unremunerative in terms of both currency and sterling. Passenger receipts as a whole increased by 5·32 per cent. in currency but were 6·88 per cent. lower in sterling. Goods traffic receipts on the other hand improved by 17·14 per cent. in currency and by 6·31 per cent. in sterling. Coffee traffic, the mainstay of the company's revenue, brought in £43,758 more, and there was a satisfactory increase in general goods. Working expenses in currency increased by 6·38 per cent., but in sterling were reduced by 4·95 per cent. Wages and salary increases, forced on the company, obliged additional expenditure under pay rolls of 2,930 contos, the company had to pay more in currency for imported fuel, stores, and materials, and

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an additional 11·52 per cent. ton mileage of paying traffic was effected.

	1934	1933
Passengers	28,240,401	27,380,645
Goods and livestock, tons	1,581,117	1,453,282
Operating ratio, per cent.	76·38	81·96
	£	£
Passenger receipts	313,100	335,527
Goods and livestock receipts	845,980	795,777
Gross receipts	1,303,213	1,277,694
Working expenses	995,330	1,047,205
Net receipts	307,883	230,489

After making provision for prior charges, &c., a balance of £11,937 is left to be carried forward.

* * * *

Great Western of Brazil Railway

Consequent upon good crops, and reduced tariffs in zones of road competition the volume of goods handled in ton-kilometres during 1934 increased 6·2 per cent. in comparison with 1933, and the number of passengers also showed some advance, largely due to reduced fares. In spite of the increased tonnage handled, and the reduction in working expenses, the net receipts, though showing an improvement of £70,123, were, after allowing for exchange losses of £15,320, insufficient by £10,290 to cover the annual charges for debenture interest and sinking fund.

	1934	1933
Kilometres open	1,742	1,742
Passengers	2,548,621	2,347,289
Tons of goods	1,200,349	1,134,466
Goods, ton-km.	84,441,317	79,524,080
Operating ratio, per cent.	76·15	91·74
	£	£
Passenger receipts	103,035	117,522
Goods receipts	341,163	378,212
Gross receipts	478,774	533,493
Working expenses	364,574	489,416
Net receipts	114,200	44,077

Mr. Eugenio Gudin, one of the directors, is negotiating with the Brazilian Government, with a view to amending the concession under which the line is operated.

* * * *

"Underground" Final Meeting

The final meeting of the Underground Electric Railways Company of London Limited to which brief reference was made last week marked the passing of a famous undertaking by means of which transport in London was brought to a fine art. The company was formed in 1902, mainly with the object of electrifying and equipping the Metropolitan District Railway in which it had a large interest. It also financed the construction of what were then known as the Charing Cross, Euston & Hampstead; Great Northern, Piccadilly & Brompton; and Baker Street & Waterloo Railways, which were later on amalgamated under the title of the London Electric Railway Company. The "Underground" group subsequently included the Central London and the City & South London Railway Companies, and by the end of 1913 had secured control of the major part of the underground system of railways in London. In the meantime, turning its attention to surface transport, it acquired a considerable interest in buses and trams so as to secure as far as possible a co-ordinated system of travel, which has been a boon to all London. Its many activities are now merged in a larger system, and the work which it began will be continued upon a more complete scale, and with greater financial resources. Without the London Transport Act of 1933 it would not have been possible to complete the unification of the interests of all the separate transport undertakings in the London area, including those of the main line railways. But to the "Underground" belongs the credit of having proved that only by real co-ordination could the demands of London for improved transport facilities be met.

L.N.E.R. Speed

A study of the schedule of the accelerated Scarborough Flyer of the L.N.E.R. shows that the 156·7 miles from Hatfield to Selby are booked to be covered in 142 min., at an average of 66·2 m.p.h., and even with allowance for the fact that these are pass-to-pass and not start-to-stop times, this is easily the fastest schedule of its length in Great Britain. Moreover, there are lengthy grades of 1 in 200 and 1 in 178 included in this timing, which on the inaugural run were surmounted without the speed of the train falling below 55 m.p.h.—indeed, the minimum at Stoke Summit was as high as 56 m.p.h.—and the 20·6 miles from Werrington to Stoke were completed at an average of 63·1 m.p.h., notwithstanding the fact that the train carried two coaches additional to the 350 tons contemplated in the schedule. It was unfortunate, as mentioned in the description of the run appearing on page 66, that the breakdown of a train ahead resulted in a late arrival at York, but the details of the performance clearly show that, even with a train of 420 tons behind the tender, the 3-hr. schedule from King's Cross to York is within Pacific capacity. It is a tribute to L.N.E.R. acceleration that on Saturdays there are two expresses booked to cover the 156 miles from London to Doncaster in 154½ min., one in 155 min., two in 157 min., one in 158 min., and one in 163 min., while the 165 min. of the 5.30 p.m. down includes a 2 min. stop at Grantham. In the reverse direction there are bookings in 153, 154, 161, and 162 min., and two trains on Saturdays make the run in 160 min., each with two intermediate stops.

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Inter-Railway Running

There are many ways in which today the friendly relations between British railways manifest themselves. Among them through running of trains by one railway over the lines of another, independent of running powers, is becoming increasingly common. During the summer, for example, excursions of the scenic variety have been taking place from stations in the North Eastern Area of the L.N.E.R., involving the use of L.M.S. metals. One such has been from Middlesbrough through Darlington, Barnard Castle, and Kirkby Stephen to Appleby, whence the train proceeded, with L.N.E.R. motive power—and, of course, with an L.M.S.R. pilot driver and guard—over Ais Gill summit to Garsdale and Hawes. From here the use of L.N.E.R. metals was resumed, down Wensleydale to Northallerton, and so back to Middlesbrough. Another trip was from York to Northallerton and Hawes, and from there over the L.M.S.R. to Settle, Skipton, Bolton Abbey and Ilkley, whence L.N.E.R. metals were followed back to Starbeck and York. Two very delightful round trips, without change of carriage—or engine—were thus made possible. Similarly amicable inter-railway relations are noticeable in France. The Etat express railcar which works daily between Dieppe and Nantes, for example, uses Paris-Orleans metals instead of those of its own administration between Angers and Nantes, and its journey is expedited in consequence.

* * * *

Poland's Railcar Enterprise

Striking improvements in Polish train services have been brought about this summer by the widespread introduction of fast railcar services. The fastest of these runs between Warsaw and Katowice, and covers the 197·5 miles in 191 min., inclusive of five intermediate stops. Between Piotrkow and Czestochowa the car is booked in both directions over the 53·4 miles in 46 min., at a start-to-stop average of 69·6 m.p.h., and this is the fastest run in Poland. Another fast timing is between

Warsaw and Koluszki, 65·2 miles in 62 min. The overall timing of just over 3 hr. compares with a best time by the previous express service of about 4¾ hr. Two cars are run in each direction daily over the 252·7 miles between Warsaw and Gdynia, taking from 5 hr. 16 to 26 min. on the journey, as compared with a normal time of 7½ hr. Between Warsaw and Cracow there is an express railcar each way, covering the 198·6 miles in 3 hr. 31 min., including three stops, and with intermediate mile-a-minute bookings; this is normally a journey of 5¼ hr. Another fast service is maintained between Warsaw and Torun, the 145·9 miles being completed in 146 min., and including start-to-stop times of 77 min. for 78·2 miles, and 66 min. for 67·7 miles; by steam train this journey requires 3¾ hr. Over shorter distances there are four express railcars in each direction daily between Warsaw and Lodz (80·7 miles in 100 min.), and three between Katowice and Cracow (48·4 miles in 54 to 56 min., including three stops). The speed of rail transport between the principal centres of population in Poland has thus been revolutionised.

* * * *

The Welwyn Inquest

It came as a great relief to know that the coroner's jury, who inquired into this serious accident on June 15, did not consider that it was brought about by an act of carelessness, but from a temporary loss of memory and an error of judgment on the part of the Welwyn Garden City signalman. A verdict of " accidental death " having thus been returned and the man acquitted of any criminal intent, allows for comment on the cause of the accident to be made. But in view of the fact that what this man told the coroner is not supported by the evidence of the corresponding signalman at Hatfield No. 3 to the south of him and at Welwyn North to the north of him, it is still advisable to make no comment but await the report of Colonel Mount and hear what is his opinion. We shall be interested, too, to see what he recommends as a preventive of future similar accidents. Meanwhile, it is a satisfaction that it was not a case of ignoring or misreading signals. Such a possibility was scarcely to be thought of, as the line is straight and the signals well placed and distinct. The evidence showed that there was no track circuit. As Mr. Barrington-Ward observed: " If this section was track circuited right through you could positively have only one train in it at any one time, but that is not the usual practice on an open section of line like this."

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The Hazelwood Derailment

A typical line, in a country district, is the Wirksworth branch of the former Midland Railway immediately north of Derby, which has its terminus in the Matlock area. The traffic over it is light and infrequent; the most valuable commodity carried is milk. On the evening of February 20 last a passenger train was on its journey from Wirksworth when, just after it had passed through Hazelwood station, it was wholly derailed; the engine, of the 0-6-0 type, and tender fell on their left side and the driver was killed. The accident was inquired into by Colonel Trench and his report is briefly summarised on page 70. The track evidently was in a very poor condition—loose and low joints; loose and defective keys; loose spikes and defective trenails. Whilst these conditions were no doubt aggravated by the rails being only 21 ft. long and many of them laid fifty years ago, Colonel Trench " can see no justification for the existence of many defects of this nature and . . . the permanent way staff must be held responsible in no small degree for the derailment." There was no speed restriction so he does not think that any blame should be attributed to the driver, even though he was travelling at a speed nearer 50 than 40 m.p.h. Moreover, the district permanent way inspector, who had been in charge of the area for five years, had often seen passenger trains which he considered were running at 55 m.p.h., and at speeds higher than he would like, but he had not reported them as there was no speed restriction. In conclusion, Colonel Trench says that the company has given instructions as to a speed restriction and that the short rails are to be replaced next year.

* * * *

Detection of Rail Flaws

The name Sperry is indissolubly connected with the detector car used for testing invisible defects in rails in the track. It has been one of the most important developments of recent years on American railways for safeguarding travel and improving the general standard of the permanent way, for by its means it has been possible to detect, without any disturbance of track or traffic, flaws in rails to which the transverse fissure had become almost a menace under the very arduous conditions American rails are called upon to endure. Latterly a Sperry car was brought over to France where it has done good service. These developments have, of course, already been fully described in our pages and those of *The Railway Engineer,* and we are now in a position to say that a new car, simplified by not being self-propelled, and incorporating the latest refinements, including ability to test rails carried in chairs, is under construction in the U.S.A. for service in Europe. An interesting development of the Sperry detector car has recently been installed at the Saulon permanent way depot of the P.L.M. Railway for testing secondhand rails prior to their being cropped and relaid on secondary lines. The results are said to have been very satisfactory and to have justified the outlay. Eventually, perhaps, all rails in running lines may be subjected to tests while they are in service, but in the meantime the installation of a detector plant at the permanent way depot is a useful innovation. At a time when both axle loads and speeds are increasing, the latter at an unprecedented rate, attention to the permanent way assumes greater importance than ever before.

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South African Locomotive Tests

The paper entitled " Scientific Research on the South African Railways " read by Dr. C. V. Von Abo at a meeting of the South African Institution of Engineers contained some interesting comparative figures arising from tests made with three classes of locomotives to determine, by the aid of a dynamometer car, their respective coal and water consumptions. The engines concerned were the 8th class (4-8-0), the class 15-A (4-8-2) and a new class designated 16-DA (4-6-2). Coal and water consumptions per indicated-horsepower-hour were respectively, 5·8 lb. and 35·4 lb. (8th class), 3·25 lb., and 22·4 lb. (class 15-A), and 2·75 and 19·5 lb. (class 16-DA). It will be noted that the last engine used approximately 15 per cent. less coal than the class 15-A which is considered to be an efficient type of locomotive, whilst the smaller water consumption is a factor influencing water supplies and scale formation in boilers. Structural difficulties on the railway naturally limit improvements, but it is reckoned that an average increase in power output efficiency of between 10 and 15 per cent. is possible for all classes of engines, and as about 2½ million tons of coal are used annually for locomotive purposes an eventual annual saving of even 10 per cent. in the coal bill represents a very large sum of money.

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Exceptional Rates and Agreed Charges

INTERESTING figures were submitted to the Railway Rates Tribunal in connection with the annual review of railway charges regarding the large number of exceptional rates which have been granted by the railway companies in recent years. The companies' powers to grant such rates are limited by the Railways Act, 1921, as modified by the Road and Rail Traffic Act, 1933, which authorises them to grant exceptional rates provided that those between 5 and 40 per cent. below the appropriate standard charge are reported to the Minister of Transport, and those more than 40 per cent. below the standard are approved by the Rates Tribunal. The extent to which such reduced rates have been introduced can be gauged from the fact that during the seven years ended December 31, 1934, considerably over 900,000 were adopted. The slight improvement in trade which was manifest during 1934, however, coupled with the introduction of the new agreed charge arrangements as from January 1 of that year, has caused an appreciable diminution in the number of reduced rates granted for merchandise traffic compared with former years, but nevertheless large numbers are still being quoted, those for freight train traffic during 1934 totalling 88,000 as compared with 125,000 in 1933. The fact that the largest proportions of these reduced rates related to coal, iron and steel traffics appears to indicate that, in addition to meeting the competition of other forms of transport, the companies have not been unmindful of the desirability of assisting the revival of the export trade by the grant of reduced rates where this has been possible without causing difficulties elsewhere. So far as coal for inland destinations is concerned, there has been a growing tendency on the part of coal factors and others to arrange for coal from collieries situated on or near the seaboard to be forwarded to London and places on the South Coast by sea, whence in many instances, it is being distributed to destination by road vehicles. To counter this, a number of exceptional rates has been granted, but reduced rates have also been given to meet road and water competition for general merchandise traffic and to secure large consignments of traffic such as grain, oilcake, and packed manure, to rail conveyance.

So far as merchandise by passenger train is concerned, the number of exceptional rates granted was 23,000 in 1934 as compared with 19,000 in the previous year. The majority of these were quoted for the purpose of developing the railway conveyance of small quantities of traffic such as dead rabbits, vegetables, fruit and plants, which require quick transit by passenger train. The introduction of reduced rates of this character has been of material assistance in fostering local industries in many parts of the country and, at the same time, has increased rail carryings. The work of the Rates Tribunal has been lightened appreciably since January 1, 1934, as the substantial number of exceptional rates less than 5 per cent. below the standard, which are principally quoted for coal and mineral traffic, no longer requires its approval, while the agreed charge arrangements have also reduced the demand for exceptional rates. On the other hand, the work of the tribunal has been materially increased by the steady increases in the number of applications for agreed charges which require its sanction before they can be introduced. Over 200 such charges are now in operation, the applications for each of which have been individually investigated by the tribunal for the purpose of ensuring that, having regard to the net revenues of the companies, their position was likely to be better if the agreed charge were sanctioned, and that the object to be secured by making the charge could not, having regard to all the circumstances, adequately be secured by the grant of exceptional rates. While the carriage value of traffic so charged does not yet greatly exceed £1,500,000 per annum, the steady extension of the arrangement is proving of material assistance to the companies in their efforts to increase rail carryings.

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First Class Traffic

ON another page will be found an article on the question "Would it pay to abolish first class?" by a contributor who comes to the conclusion that it would not, in spite of his strong presentation, well supported by statistics, of the case for abolition. In his reasoned opinion the adoption of one uniform class would mean a direct loss in revenue of £2,766,154 per annum, with possible economies not exceeding £1,000,000 per annum. Even so far back as 1871 first class ordinary passengers on railways in Great Britain formed only 9·58 per cent. of the total, and by 1911 this percentage had fallen to 2·23. First-class ordinary receipts which in 1871 contributed 23·70 per cent. of the total passenger receipts were in 1911 only 8·97 per cent. These figures do not include season tickets, which were not separated into classes until 1913, when the new form of accounts prescribed by the Railways (Accounts and Returns) Act, 1911, came into operation. With the inclusion of season tickets equated on a basis of 600 journeys per annum the case for first class makes an improved showing, as in 1913 first class passengers on all British railways were 5·68 per cent. of the total and first class receipts 11·67 per cent. of the total. The corresponding figures for 1923 were 5·76 per cent. and 11·55 per cent., but they had fallen in 1933 to 3·48 per cent. and 8·81 per cent. respectively. On the four group railways in 1934 first-class receipts were £4,562,086, or 9·02 per cent. of the total passenger takings. The 1934 percentages of first class receipts to total passenger revenue were on the Southern 10·1, L.M.S.R. 9·2, L.N.E.R. 8·96, and Great Western 6·88. Looking at the number of seats (or berths) provided by the four companies in relation to the journeys made (assuming that each season ticket holder makes 600 journeys per annum) the average annual number per first class seat in 1934 was 146 and per third class seat was 532, and the average earnings per seat were only £14·40 for first class against £21·11 for third. Having regard to the fact that third class accommodation is cheaper to provide than first it may be assumed that greater profits are made from a third class than from a first class passenger for the same length of journey.

On these figures the case for general abolition of first class would seem at first sight to be overwhelming on the operating side. The adoption of one uniform class would clearly lead to appreciable economies. First cost of construction of new stock would be less, coal consumption would be smaller owing to reduction in the weight of trains which would be caused not only by the abolition of the extra class but also by the greater passenger content of the uniform class vehicle. Other economies likely to result would be the saving of clerical labour and accountancy, reduction in time occupied in marshalling trains, reduction in stocks of carriage equipment, and reduction in cleaning and lighting and lubrication of vehicles. These economies are estimated by our contributor to amount altogether to not more than £1,000,000 a year, and the question for the companies is whether these are likely to exceed the undoubted loss of revenue which would result from the general abolition of first class. Though first class season

ticket revenue of the four group companies as a whole continued to fall in 1934, there was a slight revival in first class ordinary travel, stimulated no doubt both by the improvement in trade and the introduction of monthly tickets, and this tendency is being continued to some extent during the current year in consequence of the new 1½d.-a-mile monthly tickets and the lower scale for cheap day tickets. However small first class revenue may be at the present time in comparison with third class receipts, it nevertheless represents a substantial figure—£4,562,086 for the four companies in 1934. The loss in revenue likely to result from the general abolition of first class cannot be measured solely by the excess over third now paid by first class passengers. There is also the possibility of the diversion of former first class passengers to the road.

On all British railways in 1933 first class passenger receipts amounted to £4,800,245. A diversion of 10 per cent. to the road would involve a loss of £480,000. Of the remaining 90 per cent., those using ordinary fares would pay £1,541,227 less, and season ticket holders would pay £363,895 less and the total direct loss in revenue resulting from the change would then be £2,385,122. This loss might, however, be increased very considerably if the most influential section of the travelling public was antagonised by the abolition of first class accommodation, and it retaliated by diverting traffic from rail to road. The possibilities of such antagonism cannot lightly be disregarded because of the general indifference with which the final abolition of second class on all but Continental boat trains, and Great Northern and Great Eastern suburban services, was attended. Second class had—with the abovementioned exceptions—been abolished by the end of the nineteenth century on the chief Northern lines except the London & North Western and Lancashire & Yorkshire. Attempts had been made from 1895 onwards to revive this traffic on the two last mentioned lines, on the Great Western, and on the Southern lines by a considerable reduction in second class fares except on Continental boat trains, but the second class accommodation generally provided was but little different from third and tended to be reduced and overcrowded so that passengers gradually ceased to use it and transferred themselves to third.

One uniform class would no doubt make for greater simplicity for the larger part of the travelling public, and railway practice would be brought into line with road practice. Many branch lines also are now being worked wholly or partly by railcars of uniform class, and this innovation has been introduced without much demur. Again, however, it must be borne in mind that these last-mentioned changes chiefly concern short distance journeys, and the acquiescence of the public in this alteration is no criterion of the feelings of longer distance passengers on main line trains. A considerable proportion of these passengers would still require and be ready to pay for superior accommodation, as is evidenced by the popularity of Pullman cars, and would miss the greater privacy now afforded by first class. It is extremely unlikely that first class sleeping cars could advantageously be abolished, and the provision of these and of Pullman accommodation on main line trains would still detract from the weight saving economies which would otherwise result from a strict adherence to one uniform class. One suggested economy, having one class only of restaurant car as is the usual practice on the Continent, could be obtained without abolition of first-class railway carriages. Though a considerable reduction in the first cost of providing accommodation would result for a time if first class had no longer to be constructed, yet a demand for a general improvement in third class travel would almost inevitably be forthcoming, so that this particular economy would be largely modified. Our contributor arrives at the conclusion that the economies to be expected from the abolition of first class would be hardly more than one third of the potential losses in revenue, and that for the present, at any rate, it would be the better policy to retain two classes.

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The Rail Wear Problem

IN common with many other classes of material which are used extensively in railway service, the steel rail is today coming more closely under review than ever before. It is well that this should be so, in view of the vastness of the wear problem. As we have previously emphasised, the annual consumption of rails by British railways probably represents their largest individual purchase, in each case, in the course of a year. The conditions of use become unceasingly more exacting; and this is reflected in the increased rapidity of wear, as well as in a definite tendency towards increase in the number of rails fractured while in service. Various steps have been taken in an attempt to make the life of the rail keep pace with the changing conditions; the increased percentages of manganese now in general use have been very helpful in this direction, and they are being supplemented on the L.N.E.R., L.M.S.R., and Southern Railways, by the replacement of 95 lb. rails with 100 lb. rails where the traffic conditions are sufficiently heavy to warrant the change. The value of heat treatment is increasingly coming under recognition, and the purchase by one British railway in a single year of ten thousand tons of rails treated by the regulated sorbitic process offers a striking testimony to the progress that has been made in this direction.

The fact seems beyond dispute, however, that as yet we know but little, either of the factors that make rail-wear what it is—and the variations that are experienced in wear, even of rails which should theoretically display similar, if not identical, characteristics, are often extremely puzzling—or of the best and most reliable ways in which it may be diminished. It is for this reason that such a paper as the one read before the Permanent Way Institution, at the recent meeting in Glasgow, by Dr. A. McCance, Chief Chemist for a Scottish firm concerned in the production of rails, is so valuable. It represents the concentration of a mind not trammelled by any of the fixed ideas of the rail-user, on a problem which is both of importance and of deep interest. In our summary of the paper, which will be found on page 56 of this issue, it will be seen that Dr. McCance divides the causes of rail-wear into two components. One is rolling wear, or, strictly, compression; and the other is sliding wear. We consider that he might, perhaps, have devoted more attention to the matter of alternating stresses caused by the constant contraflexure of the rails about the chairs, as there can be little doubt that this is an important contributory to the fatigue that may produce breakages, especially if the support of the sleepers by the ballast is not beyond rebuke. But it may be, of course, that the speaker thought it wiser, in an audience composed entirely of those responsible for the maintenance of the track, to assume something approaching perfection in its support.

Much of interest was said in regard to causes of wear. The problem of the sudden drop in the rail-wear curve, in the earliest stage of the rail's life, before the curve flattens out to the normal rate of wear, was explained by the poor wearing quality of the decarburised outer skin of the rail—an argument which might, indeed, be

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used against the practice of wash-heating rail ingots between the blooming and the roughing rolls at the mill, which tends to give a double decarburisation effect. The reason for excessive wear in tunnels was explained as being due to the combination of moisture with the sulphur dioxide from the tunnel atmosphere, to produce a strongly corrosive medium; and the interesting fact was mentioned that copper, which is so valuable in resisting acid corrosion in a mild steel, tends to have the opposite effect in a high carbon steel. This has been proved by experience by at least one British railway which has tried copper-bearing rails in a tunnel where the corrosion problem is serious. A chromium analysis containing 3 per cent. of chromium was suggested as a possible palliative; in first cost this would be expensive, but as a resistant to chronic corrosion it might well prove to be economically justifiable. A manganese content in ordinary rails of from 1·0 to 1·3 per cent. was commended as giving a more homogeneous structure, less likely to abrade away under traffic than a low manganese, and this again is the experience of all those who are now using the medium manganese rail in preference to the previous high carbon rail. Finally, and perhaps most significant of all for the future of rail steel compositions, Dr. McCance drew attention to the valuable properties, in reducing wear, of thin films of oxide on metal surfaces. These films are normally always present, though generally invisible, and experiments had shown that, when steps were taken to prevent their formation, wear was accelerated. Thus steels which form such films rapidly after they have been worn off would obviously have better wearing properties than those which do so more slowly. Dr. McCance quoted a remarkable new steel rail in Germany which contains the high phosphorus content of 0·18 per cent. and the wear of which has been reduced by about a quarter. The ability of phosphorus to oxidise readily may probably account for this. Such a paper as this is a thought-provoking contribution to progress in this important realm.

* * * *

100 lb. Rails

AFTER some three decades during which the 95 lb. per yd. bull head rail section has been standard for main line use on the majority of British railways, a definite move is now being made in favour of the 100 lb. rail. This is hardly to be wondered at, seeing that the rail section has remained unchanged during a period when axle-loads, train loads, and the average speed of traffic, have been steadily on the increase. The Southern Railway has begun to lay the 100 lb. B.S. section on its most heavily trafficked lines, including a certain proportion heat-treated by the regulated sorbitic treatment; whereas the L.N.E.R., which has led this movement towards 100 lb. rails, and the L.M.S.R., are using a slightly altered section, of which the web and foot conform exactly with those of the revised 95 lb. section. The effect of this alteration is to transfer $\frac{1}{32}$-in. of metal from the foot of the rail to the head, so that the head has $\frac{3}{16}$-in. additional metal on top, which should permit of at least 25 per cent. longer life before replacement becomes necessary, as compared with $\frac{5}{32}$-in. only in the unrevised 100 lb. B.S. section. It has to be remembered that in earlier years both the Midland and Great Northern railways were extensive users of 100 lb. rails, so that in these cases nothing more is involved than a reversion to former practice.

LETTERS TO THE EDITOR

(The Editor is not responsible for the opinions of correspondents)

Locomotive Headlights

London, S.W.1.
July 6

To the Editor of The Railway Gazette

Sir,—Now that the cause of the Welwyn accident has been revealed by the coroner's inquest, I would like to suggest as a proposition for argument that this collision (and a number of others) would not have occurred had the engines of the trains involved been equipped with the type of electric headlight used for some 30 years abroad and now almost universal outside Europe.

Had the engine of the colliding train been provided with such a headlight the driver would have seen the preceding train for at least 800 yards, and the signalman would have been recalled to his senses by the glare of the oncoming headlight.

I believe that I am right in stating that since these lights have been installed abroad the number of head and tail collisions has been reduced to negligible figures, and a number of collisions which would have occurred due to wrongly set points have been prevented. In addition a number of other accidents due to sabotage by removing rails, washouts and straying animals have been avoided.

My own experience on the footplate with the type of lighting in use here is that it is useless to expect to see obstructions till it is too late (tail lights here are also very poor), and as the signals are usually above and away from the line of travel, the mere fact of concentrating on signals withdraws the drivers' attention from the track in front and engenders the feeling that it is no good looking for obstructions if the signals are clear. With the good headlight day conditions exist, as both the line and signals can be seen up to a mile on the straight.

Perhaps some of your readers will be sufficiently interested to criticise the above and some of your colonial readers may be able to give objections to such lighting based on actual experience.

C. M. E.

The L.M.S. Liverpool-London Run on June 27

28, Ashburn Place, S.W.7.
July 6

To the Editor of The Railway Gazette

Sir,—There is no doubt English engines are slowly improving, as the recent Liverpool-London run recorded in your issue of July 5 shows, but there is still a good deal of lee-way to make up as may be gathered from the following comparison between the L.M.S. run and that which I recorded recently with a Paris-Orleans rebuilt Pacific locomotive on the Nord with a train of the same weight (see *Engineering* of March 1 last). The P.-O. locomotive weighs 101 tons and the L.M.S. 104½ tons, both in working order and exclusive of tender. The P.-O. engine on this occasion was burning fuel of no more than ordinary quality. On the L.M.S. the 3¼ miles up Madeley bank at 1 in 177 were mounted with a minimum speed of 57·7 m.p.h. On the Nord the 7 miles up Caffiers bank at 1 in 125 produced a minimum speed of 55·3 m.p.h. On the L.M.S. the minimum up the 6 miles of Tring bank at 1 in 330 was 67½ m.p.h. at the summit compared with 70 m.p.h. at the summit of 12 mile Survilliers bank at 1 in 220. The P.-O. Pacific is, of course, a compound with a working pressure of 246 lb. per sq. inch and a large superheater producing a temperature of about 750° F. The L.M.S. Pacific is a four-cylinder simple working at 250 lb. per sq. inch boiler pressure with a smaller superheater. The P.-O. Pacific has a double blast pipe, the L.M.S. a single blast pipe. I note with interest that the new L.M.S. turbine locomotive has a large superheater with steam superheated to 750°, and double blast-pipe.

Yours faithfully,
MONKSWELL

PUBLICATIONS RECEIVED

Map of India. John Bartholomew & Son Ltd., 12, Duncan Street, Edinburgh. 36 in. × 30 in. (folded to 8½ in. × 5 in.). In contour colouring. Scale 1 : 4,000,000. Price 6s. net.—This excellent map of India appears to be up to date in so far as new railways are concerned and gives all important roads and canals also. It is, however, defective in one or two important details in that it does not show the Indus bridge between Mari Ghat and Kalabagh, nor is the Ava bridge over the Irrawaddy at Sagaing correctly shown. It is a combined rail and road bridge, but both rail and road appear to be shown as crossing the river at different and incorrect points. On the whole, however, this is a very valuable map, replete with information of all kinds.

F.B.I. Register of British Manufacturers : 1935-36. London : Federation of British Industries, 21, Tothill Street, S.W.1. 9½ in. × 7 in. × 1¾ in. 660 pp. Price 15s.—The annual register of members published by the Federation of British Industries has established itself as a work of business reference by the comprehensive nature and convenient indexing of its contents. These features again characterise the latest issue, which retains the useful arrangement of firms listed both alphabetically, with their addresses, and under their products and services. The section giving brands and trade marks is no less valuable, while the stimulating articles in the introductory pages under the heading "About Britain" should be a spur to industrial endeavour. The development committees of the Federation exist for the purpose of smoothing the way for those who wish to explore the many commercial possibilities offered by this country.

The Unified Transport System of the U.S.S.R. By K. N. Tverskoi. The New Soviet Library Series. London : Victor Gollancz Limited, 14, Henrietta Street, W.C.2. 7½ in. × 5 in. 176 pp. Folding map. Price 3s. 6d. net.—This volume adds one more to the long list of books in which the doings of the Soviet and the present-day conditions in the U.S.S.R. are dealt with in the manner immortalised by Ko-Ko when answering awkward questions regarding the fate of the heir-apparent to the throne. It is typical in implying accomplishment when too often merely planning has been achieved. All forms of transport are covered, and the book forms a good guide as to what the Soviet authorities propose should be done to improve communications. Few readers will be misled by the belittling of the admittedly small accomplishments of the Tsarist *régime*, and the exaltation of the activities of the post-Revolutionary authorities, for the author adopts the simple expedient of neglecting the effect of the world advances in science during the last 20 years, and credits Communism with the ability to have performed in 1914 what it has done within the last seven years. Some of the Soviet transport achievements really are remarkable, but the railway and road systems as a whole are still in a very backward condition, and no one reading M. Tverskoi's book would be led to imagine that it is a common thing for two full and uncomfortable days to be spent in journeying down the main line from Moscow to Rostov, a distance of about 750 miles. It is a pity that such an excellent opportunity of presenting the facts about transport in the U.S.S.R. should have been lost by a slavish adherence to Soviet propaganda principles. The author even goes so far as to term the construction methods of the Baltic-White Sea canal as "a grand experiment in re-educating people who had strayed from the straight and narrow path." Actually, the working conditions were indescribably bad. It is with a feeling of regret that one lays down the book—regret that the author himself has not kept to the straight and narrow path, for the text is written in a pleasing style that is worthy of a book which would face the facts, and is backed up by a useful map of railway and water transport from Poland to the Behring Sea.

Rambles and Walking Tours in Somerset. By Hugh E. Page. London, 1935 : The Great Western Railway, Paddington Station, W.2. 7 in. × 4½ in. 127 pp. Price 6d. net.—There are many places in Somerset so beautifully remote that their admirers may begin to feel some alarm at Mr. Page's action in revealing them to the first vandal with sixpence to spare. They will be reassured on reading the author's foreword, however, for he has graded his rambles discreetly, so that only the stout of heart and strong of sinew are introduced to the innermost mysteries of the county, while the dilettantes who make a seaside resort the centre of their excursions ("seaside visitors, who may not be experienced walkers," Mr. Page calls them) are guided by shorter and smoother paths where they are no detriment to the landscape.

This is first and foremost a practical book, both in size and contents. The author and publishers have recognised that a work of this kind is designed to be used rather than read. Hence its eminent suitability for the pocket, its concise directions and freedom from "guide book" verbiage, and its excellent maps. These are not of the folding variety that, under the influence of the lightest zephyr, become as hard to manage as a windjammer in a hurricane, but are printed on the pages themselves and give a wealth of relevant and legible detail in a convenient compass. There is, however, one folding map, but this shows all the rambles in relation to one another and to the county as a whole. It assists those who wish to weld the separate units into a single and comprehensive walking tour, and is not supposed to be used for finding one's way when lost in a rainstorm.

Electricity for Shareholders.—A most attractively-produced brochure has been issued by the General Electric Co. Ltd. to its shareholders in order to keep them fully informed as to the advance in the various branches of the company's manufactures, and thereby assist in making the products known still further. The equipment illustrated and briefly described varies from the winding and coal-washing plants and turbo sets made at the Fraser & Chalmers' works at Erith, to the Jubilee floodlighting equipment of the Osira type for Buckingham Palace, Osram lamps, G.E.C. radio sets, and household appliances.

Aluminium Sections.—The British Aluminium Co. Ltd., Adelaide House, King William Street, E.C.4, has added another booklet to the useful series dealing with the properties, applications, and working of the metal. The present example deals with aluminium sections, and the profiles shown in its twenty illustrated pages are reproduced full size. It is pointed out in a foreword that the metal lends itself readily and cheaply to production in varied and intricate shapes, for which purpose the company possesses over three thousand dies. The possibilities of aluminium in architectural work are emphasised by the many mouldings available for such purposes as window frames and window sills, surrounds and architraves, drip plates and gutterings, and miscellaneous beads, cappings, balusters, and newel posts.

Golf Courses.—The large folding map at the end of this G.W.R. booklet is so studded with small red flags denoting golf courses that one is disposed to wonder how adequate particulars of them all can be contained in such a handy compass. The feat has, however, been admirably accomplished, with the courses arranged in alphabetical order under counties and briefly particularised as to charges, membership, number of holes, means of access, and other essentials. A breezy foreword, calculated to send the most conservative reader on a voyage of discovery to new scenes, is written by Peter Lawless, Golf Correspondent of *The Morning Post*, and illustrated with amusing sketches by "Mel." There is a short hotel guide at the end of the booklet. As a further spur to golfing endeavour, the Great Western Railway has ventured into humorous pictorial publicity with a poster headed "the West has always been the best," showing a golfer of today surveying with delighted admiration the curling moustache of his Victorian counterpart. Both by its lively colouring and technique and as a departure from the company's usual poster policy, this should attract much attention.

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THE SCRAP HEAP

A 'VARSITY RAILWAY TIE

The Cambridge University Railway Club has adopted what is believed to be the first railway club tie. It has as a background light blue for Cambridge University, across which are the colours L.N.E.R. green, G.W.R. cream, L.M.S.R red, and Southern green.

* * *

THE BITER BIT

A third class passenger, travelling from Paddington to Bristol, and who wished, during the journey, to go through a quantity of rather intricate business papers, was particularly anxious to secure a compartment to himself. All appeared to be going well, when only half a minute before the train was due to start, there appeared at the door of the compartment an anxious looking gentleman who, however, seemed doubtful about entering. The following then ensued:—

Anxious gentleman: "Does this ——? "

Other traveller (irritably). "No, it does *not*."

A. G. "Oh, dear, I hoped it did."

O. T. (*sotto voce*). "I'm d—d glad it doesn't."

Guard (to woman passenger with three small children, dog and canary). "Come along madam, hurry up, please, plenty of room here; gentleman all by himself. Bristol? Yes, first stop."

* * *

THE ADAMS "WINDSPLITTER" OF 1900

"On May 26," reads the *Railway and Engineering Review* of June 2, 1900, "a 58-ton locomotive drawing the six cars that constitute the Adams trains made the 40-mile run from Baltimore to Washington on the Baltimore & Ohio in 37 min. 30 sec. This time covers the start from a standstill, the slow speed demanded by the laws and ordinances of both cities in entering or leaving and the minute or more consumed in coming to a full stop, as well as the slackening at the relay viaduct. The run is said to excel all speed records on the B. & O. between the two cities. Several miles were made at the rate of 41 sec., and 8·1 miles were made in exactly 6 min." The *Railway and Engineering Review* of August 11, 1900, also says, "It is reported that the Adams cigar-shaped train which is being tried on the B. & O. made the run between Philadelphia and Baltimore on August 7, a distance of 97 miles in 1 hr. 41 min. A speed of 82 m.p.h. was attained at times." This streamlined train was invented by Frederick U. Adams and constructed in the Mt. Clare shops of the Baltimore & Ohio. It consisted of one baggage car and five coaches, whose sides were covered with corrugated sheets and extended below the sills. To heat the cars, hot waste air from the firebox was forced through a duct under the roof of all cars. The train was tested between Baltimore and Washington, and later between Baltimore and Philadelphia. After a few minor mishaps with the extension below the sills, the train was removed from service.—*From the "Railway Age."*

* * *

During the construction of railways in England many valuable archæological finds have been unearthed, and railway engineers in the course of their bridging and excavations have revealed palæontological remains of great scientific value. A valuable collection, now on permanent exhibition at the Derby Railway Institute, contains priceless Anglo-Saxon remains. These interesting relics of the past were dug up near Saxby, Leicestershire, in August, 1890, during the construction of the Saxby curve, and comprise cinerary urns, fibulæ, rings, beads (porcelain, amber, and glass), bronze tweezers, spear heads, shield bosses, sherds of various kinds, &c. Some years ago, Professor Baldwin Brown, the famous archæologist, made an intensive study of these remains, and describes them very fully in his work, "The Arts in Early England."

* * *

About 1844, a Mr. Thomas Banks, the head of a large engineering works in Manchester, had occasion to attend a board meeting of the directors of the old Midland Railway Company at Derby, on the subject of his patent rights in connection with the manufacture of steel tyres and wheels. During the course of the negotiations he was asked by the directors to cancel his former agreement with them, and, on his hesitating, they said, "You seem afraid to trust us, Mr. Banks!" To this the engineer replied, "Oh, no, I am not afraid to trust you as private gentlemen, but when you get altogether in this room, I'll trust none of you!"

One Hundred Years Ago

Extracts from the July, 1835, issue of "The Railway Magazine" (afterwards "Herapath's Railway Journal") and the oldest constituent of THE RAILWAY GAZETTE

MONEY FOR RAILWAYS

To the Editor of the "Railway Magazine."

Friend Editor,

It appears to me that if all the money that is expended in Acts of Parliament, for Poor Law Commissioners, and many other attempts to benefit the poor and relieve the ratepayers, were judiciously employed in making railways from the Metropolis through every county in England, it would do more to promote a general good in five years than can ever be effected by any other. The first thing that is thought of in America among the new settlers is to make a railroad, remembering that "good roads constitute the wealth of kingdoms." We Englishmen are asleep.

Thy friend,

Y—Z.

RAILROAD IN PRUSSIA

The Prussian Government has expressed its approbation of a proposition of the Provincial States of Westphalia for the establishment of an iron Railroad, to form a junction between the Wesser and the Lippe; and the committee formed at Minden for the execution of this plan has proposed to continue the road to Cologne.—*French Paper.*

LONDON AND GREENWICH RAILWAY

Yesterday some of the Directors, accompanied by the Engineer and Secretary to the Company, witnessed the working of Lord Dundonald's rotary steam-engine, with the performance of which they were much gratified. The locomotive engine already on the Railway has recently made several trips with passengers, to the great delight of that portion of the fair sex who have enjoyed the privilege, as well as astonishment at the ease, safety, and velocity of their transit. Taking the latter as an average of what may be done when the line of road is completed, it will not occupy more than ten minutes to slip along the Railroad from London to Greenwich!—*Public Ledger, June* 25.

THE "NUISANCE" OF RAILROADS

"Have you ever experienced any inconvenience since the railway was constructed?—No inconvenience whatever has been experienced.

"Are the grounds infested by people in consequence of the passage of the locomotive engines?—No.

"Is there any thing offensive in it?—Nothing whatever.

"Is there any smoke?—None whatever.

"Is there any noise?—No, it is rather an object of interest to persons residing there. (*Extracts from the evidence of Mr. Hardman Earle, a Liverpool merchant, before a committee of the House of Commons on the Liverpool and Manchester Railway.*)

THE RAILWAY PREFERRED

"As to their enjoying a communication by steam-boats, in a manner sufficiently cheap and expeditious, it may be answered that if I prefer land-carriage (which I have a right to do) and can have it so cheaply and expeditiously as by water, I have as clear a right to avail myself of that which I prefer. The associates of a steam packet are not always very delectable; and those to Gravesend, of all others, are frequently somewhat otherwise—rather proverbially so (*From a letter to the Editor*).

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OVERSEAS RAILWAY AFFAIRS

(From our special correspondents)

SOUTH AFRICA

Widows' and Orphans' Pensions

As indicated in the budget speech of the Minister of Railways and Harbours during the session of Parliament recently concluded, £100,000 has been set aside this year as a fund for widows and orphans of railway servants. The Minister and the Chief Commissioner have met representatives of the various railway unions and staff organisations and have discussed the Government's proposals. The chief point at issue is the most effective way of evolving a suitable pension scheme—whether by a system of group insurance or the establishment of an endowment fund, or a pensions fund on public service lines. Details of the proposals will be submitted to the staff in different centres and a concrete scheme will probably be adopted in the near future.

Hotel Accommodation for Tourists

At a meeting of the Standing Advisory Committee of the South African National Publicity Association held recently in Johannesburg, discussion centred largely around the question of hotel accommodation in the Union, more especially in view of the forthcoming British Empire Exhibition to be held in Johannesburg next year, when there will probably be a great influx of tourists from overseas. It was considered by the committee that the only way in which the position could be met, was by asking the Government to set aside a large sum of money to be ear-marked for the purpose of lending assistance to hotel-keepers, to enable them to proceed with schemes of hotel development. The committee therefore resolved to request the Government to appoint immediately a committee of experts with instructions to report within two months, or sooner if possible, and to suggest that in the meantime the Government should consider the feasibility of making loans at low rates of interest and on a long-term repayment basis in respect of approved applications for the purpose of building or improving hotels in the Union.

South African Airways

It is officially announced that the headquarters of the South African Airways, which are under the control of the Railways and Harbours Administration, is to be removed from Durban to the Rand airport at the end of June. Fifty members of the staff, with their families, are to be transferred to the Rand, and accommodation for the South African Airways fleet, comprising three big Junkers, three W.34's, and two F.13's, will have to be found at the airport. This, in addition to the provision of workshops and stores accommodation, has provided a problem for the airport authorities. As a start, a large workshop building and storeroom, erected by the City Engineer, Johannesburg, has just been completed. The complete accommodation, including hangars, offices, and a new meteorological station, is due to be ready by December of this year. In the meantime, the fleet of South African Airways machines will have to be parked in the open. The transfer to the Rand will necessitate a revision of the present schedules of the South African Airways passenger services. This will take effect from July 1. Additional schedules are to be introduced on August 1.

AUSTRALIA

Improved Inter-Capital Services

Timetable revisions by which the Sydney-Melbourne service is likely to be speeded up by some 2½, and the Melbourne-Sydney service by about 1½ hours, are at present being considered. In each direction the former times of arrival at and departure from Albury will be retained approximately, but later starts from Sydney and from Melbourne will be made and the times of arrival at those cities will be earlier. On the Victorian section, the "S" class Pacific type locomotives as now modified have been found capable of the faster speeds thus required with standard loads of 450, and maximum loads of 480 tons behind the tenders.

INDIA

Raising the Jhelum Bridge

Owing to the silting up of the River Jhelum at the town of that name, where the main line of the North Western Railway crosses it, it has been decided to raise the girders and track on the bridge by 4 ft., the work being undertaken under traffic. The bridge is over 4,800 ft. in total length and is composed of 50 spans each of 90 ft. clear which are up to the Heavy Mineral, or heaviest standard of loading. The spans will be dealt with in rotation from the Lahore end, individual lifts being effected in stages of 10 in. and 8 in. Five spans will be on an incline simultaneously and the incline will gradually be worked across the bridge. Special lifting girders are being made up in the Jhelum shops of the Bridge Department of the railway, and these will be attached to each span in turn. The actual lifting of each span will be carried out with four 50-ton capacity, Duff jacks, its weight being about 136 tons. All lifting will be done from the piers and no staging will have to be erected in the river bed. As the ruling grade on this section of line is 1 in 100, no trouble is expected from trains stalling. The whole work is being arranged and carried out by the Bridge Department, N.W.R.

Proposed New Railway

The Railway Budget for 1935-36 provided a sum of Rs. 10 lakhs for expenditure on the construction of a new line in South India connecting Karaikudi with Madura. The alignment of this railway was recently discussed at a meeting of the Advisory Committee of the South Indian Railway. It is now understood that the South Indian Railway Administration has referred the scheme back to the Government of Madras, pointing out that the proposed line had none too bright prospects before it. The railway will run parallel to the existing road along which a formidable motor transport service is maintained. As the Madras Government gave this project a high place in its list of recommended lines, the railway authorities have done well to acquaint the former with their views of the commercial aspects of the proposed construction.

Bengal Board of Communications

The new Board of Communications that has been appointed by the Government of Bengal to make recommendations on the programme of expenditure on road development from Bengal's share of the Central Road Fund, includes two members representing railway interests in Eastern and Western Bengal respectively. They are the Traffic Manager, Eastern Bengal Railway, and Mr. H. H. Yule, Chief Commercial Manager, East Indian Railway.

Passenger Transport Problems

At the annual dinner of the Bombay Passengers and Traffic Relief Association, an infant organisation which seeks to improve the conditions of travel in the country, its Vice-President drew attention to the hardships and difficulties which the millions of third-class railway passengers have to endure. He admitted that the question was receiving the attention of the authorities, and that a solution was not easily and readily to be found. In referring to the possibility of considerable shrinkage of railway profits as an immediate result of any substantial improvement in the conditions of third class travel, the speaker overlooked the fact that the railways have earned no profits since 1930-31. He suggested that the cost of urgent reform of third class travel could be met by greater economy, higher rates for other services or smaller expenditure on them and, only as a last resort, by increased third class fares. The Vice-President did not omit the bus services in his criticism of passenger traffic conditions.

The South Indian Railway Local Advisory Committee at Ootacamund recently considered several alternative designs of third class carriage and recommended the adoption of one known as design "C," which will be forwarded

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to the board of directors and the Railway Board for approval. The various Indian railways usually have their own designs of coaches, though of recent years the work of the Standards Committee has been directed to the standardisation of under-frames, axle-boxes and other parts. Now that the Central Standards Office has been made permanent, an effort will possibly be made to standardise coaching stock.

Further Quetta Earthquake Notes

The latest news from the Quetta area is that, in all, some 500 railway subordinates and menial staff and families were either killed or injured. Passenger traffic to Chaman, on the Afghan frontier, is being worked from Sibi, in the plains, by the Sind-Peshin (or Harnai) line, thus avoiding Quetta altogether, and leaving the Bolan route free for goods and relief working. It is remarkable that a long tunnel between Spezand and Mastung Road —on the Nuski line—which is situated approximately on a bee line between Quetta, Mastung and Kelat, the places where most of the damage was done, came through the earthquake unscathed. In fact, some special provision of Providence seems to have protected the whole of the railways which pass through and all round the affected area or areas. Only residential, station and office buildings were damaged, most of them severely.

SOUTH AFRICA

Washaways in Natal

Serious washaways occurred on the railways in the coastal area of Natal resulting from an almost unprecedented rainfall on June 12 and 13. In forty-eight hours fifteen inches of rain fell in Durban, and the fall in the outlying districts was much heavier, twenty-three inches being registered at one place. All communications by rail, road, sea and air were severed. The most serious washaway was between Dassenhoek and Delville Wood on the new main line, where 100,000 tons of filling were required to build up the washout. The track at this point was suspended in mid-air for a distance of 100 yd. over a chasm 150 ft. deep. Nearby there was a big landslide starting from the top of the railway embankment and extending far into the valley below. The tracks were swept 300 yd. away, one section being wound round trees like so much wire. Another large washaway between Shallcross and Klaarwater required about 15,000 tons of filling. A further washaway between Malvern and Escombe cut off the old main line link to the north.

Several smaller washaways occurred on the North Coast and South Coast lines and on the new main line between Cato Ridge and Durban. The old main line also suffered damage between Malvern and Pinetown. Train services were seriously dislocated, and the new main line was completely out of use until June 18, trains in the meantime being diverted over the old main line and terminating at Pinetown; passengers were conveyed to and from Durban by motor transport for several days. The ballast required for the fillings was brought from the Transvaal and Orange Free State, the bulk of it being from the mine dumps on the Witwatersrand.

Airway Passenger Insurance

As from July 1, all passengers in the South African Airways machines were issued with a free accident insurance voucher for £1,000, which policy embodies the usual benefits attached to this form of insurance. This is the first time in the history of air transport that an organisation operating regular air routes offers such facilities to passengers. The fares are in no way affected. With the introduction of multi-engined air liners and the establishment of meteorological and wireless stations throughout the Union, the possibilities of accident are considered to be reduced to a minimum. The airways services of the Union are controlled by the South African Railways and Harbours administration.

SWITZERLAND

Financial Position on the Federal Railways

Although the financial position of the Swiss Federal Railways and associated transport undertakings has been mentioned frequently in these columns as giving rise to serious criticism and genuine anxiety, it is significant that in 1934 the surplus of earnings over expenditure amounted to fr. 96,715,000, a higher figure than in either of the two preceding years. This improved state of affairs is due entirely to the determined effort that has been made to reduce expenditure, which has come down from all but fr. 260 millions in 1932 to under fr. 236 millions last year. This reduction has much more than counterbalanced the continued fall in receipts amounting to just about fr. 10 millions in the same period.

So that although the surplus is still insufficient to meet the interest due upon the capital debt, it shows a healthy improvement, which can be accelerated sufficiently to meet the interest charges only if foreign exchanges—upon which this land of tourists has so greatly to depend—become more favourable to visitors from abroad. A few comparative figures for the last three years are as follow:—

	1932	1933	1934
Passengers carried (millions)	116·9	114·9	113·7
Goods carried (million tons)	15·3	14·8	15·1
Receipts (million fr.) ...	342·9	336·6	332·9
Expenditure (million fr.)	259·7	247·1	235·9

It is satisfactory to note that the goods tonnage is beginning to show an upward tendency and even the rate of fall in passengers seems inclined to slow up, but the total fall in receipts is still serious.

CHINA

Brigadier-General Hammond's Tour

The committee of railway experts, headed by General Hammond, arrived in the capital (Nanking) from Shanghai on May 8, and discussed with Mr. Tseng Chungming, Vice-Minister of Railways, and other officials of the Ministry the plans for its inspection tour. The first railway inspected was the Tientsin-Pukow, and after a stay in Tientsin, Tangshan, a mining centre in north-eastern Hopei, was visited. The workshops of the Peiping-Liaoning (Peking-Mukden) Railway, which are situated there, were inspected by General Hammond.

Reduction of Fares

On June 1 a resolution was adopted by the Ninth Railway Traffic Conference, sitting in Nanking, in favour of a reduction of passenger fares on Government railways, and the Ministry of Railways was requested to instruct the various administrations to act accordingly.

One Year's Sleeper Order from Single Firm

It is reported that the Fairhurst Lumber Company of the U.S.A. delivered 110,000,000 sleepers to China last year, through the agency of the China America Lumber Company of Shanghai. This figure gives some idea of the new construction and re-sleepering which are going on in China at present.

NEW ZEALAND

Welding Crossings

After carrying out exhaustive tests with the electric welding of crossings, the New Zealand Government Railways administration is satisfied with the results and has decided to use this economical method of fabrication extensively in future. For the distant junction in the new yard at Wellington the welding forming the subject of the illustration on page 64 is being carried out. It consists of making up the crossings for single slips by joining the rail-pieces together by means of bars through the webs. These bars are welded to the webs all round the bar on each side of the web: the ends of the bars can be seen on the inner sides of the check rails in the illustration. In addition, the bottom flanges of the rails are welded to the bed-plates, and this work is shown actually in progress on the right in the illustration; the bed-plates can also be seen welded to the crossing in the foreground. Each crossing is welded up as a complete unit, but it is connected to the adjacent rails with ordinary fishplate joints, so that when worn, it can easily be replaced. Even where points and crossings occur in lengths of welded track, the crossing joints are not welded. Thermit welding of rails to form continuous lengths without joints has also passed the experimental stage in the Dominion.

OUR CENTENARY—MESSAGES FROM READERS

As announced in our May 3 issue, "The Railway Gazette" and the journals incorporated with it have completed 100 years of continuous publication

THE following is the tenth instalment of the many messages we have received in connection with the centenary of THE RAILWAY GAZETTE and the various railway journals now incorporated with it, the earliest of which made its first appearance on May 1, 1835. In expressing our thanks to all who have written, may we say how greatly we value their appreciative and encouraging messages.

Mr. G. Kimura, Assistant Traffic Manager, Kiaochow Tsinan Railway, Tsingtao

Being regular subscribers to THE RAILWAY GAZETTE for six years, we have become intimate friends of the esteemed weekly. Hence we feel in this memorable moment as happy as we would feel when a friend of ours celebrates his 100th birthday. May we hope that the GAZETTE will live for ever as a guiding and helping hand in the field of railway management as well as engineering. Please accept our hearty congratulations for the success of the GAZETTE in the past 100 years.

Mr. W. C. Thomas, Millars' Timber & Trading Co. Ltd., Perth, W.A.

Generally we regard the GAZETTE as amongst the best of those journals we receive serving the interests both of railways and manufacturers like ourselves, and we congratulate you on your 100th anniversary. The features of your interesting journal which we find most useful are articles and pictures relative to foreign railway services, because we are always directly interested in railway equipment, materials for trucks and sleepers for the tracks.

Mr. Phra Bhadrakich Kosol, Secretary, Royal State Railways of Siam, Bangkok

On the occasion of THE RAILWAY GAZETTE having attained 100 years' continuous publication, the Royal State Railways of Siam beg to express their appreciation of the successful issues which well deserve hearty congratulation. The subjects dealt with in the supplement on diesel traction, and the articles on maintenance of way, locomotive design, signalling, and construction of buildings and bridges, are of great interest to the Royal State Railways of Siam and are also most beneficial to our engineers.

Mr. John Bruce, Kilbirnie, Wellington, New Zealand

It might be interesting to you to know that, in my opinion, your several journals have occupied the premier place amongst railway journals published in the English language. For general excellence of reading matter, reproduced drawings, illustrations and printing, they have been without an equal. I trust that the same quality that has characterised your various individual papers may dominate THE RAILWAY GAZETTE after its amalgamation with *The Railway Engineer*. I congratulate you on your past success, and wish you well for a second century as the leading transport journal. My particular interest is your *Diesel Railway Traction Supplement*. As so many executive officers interested in diesel traction are resident abroad, and are not too familiar with the high speed diesel engine and its application to railway traction, may I suggest that in addition to the splendid matter you already publish, you print from time to time outline scale drawings and technical descriptions of the most suitable high-speed diesel engines for railway traction, British, Continental and American; also articles dealing technically with transmission systems; the characteristics of the diesel engine under the varying speed-load conditions of railway operation; the characteristics of the various electrical transmission systems, British, Continental, and American, also gear transmissions including hydraulic systems. I think that further well informed articles on these subjects would do much to enlighten executive officers and remove that feeling of risking failure with a new kind of traction.

Mr. B. G. Smith, Divisional Superintendent, East Indian Railway, Howrah

I offer you my heartiest congratulations on having completed a hundred years of continuous publication. THE RAILWAY GAZETTE is a veritable mine of valuable information on railway matters and is read with interest by a very large number of railwaymen. If any part of the journal can be said to be more interesting than the rest, this would be the editorial comments, which are invariably of great interest.

Mr. Ronald P. Unwin, Tartagal, Argentina

I have much pleasure in congratulating THE RAILWAY GAZETTE on the completion of 100 years of continuous publication, which must be almost unique in the annals of technical publishing. *The Railway Engineer* has always been of the greatest help to us engineers up country in keeping up to date with all the latest developments in the industry, and now THE RAILWAY GAZETTE continues these features in conjunction with others of a more general nature, so that all who are connected with railways find their particular sphere regularly reported upon in this really comprehensive journal.

In my opinion the most useful articles are those dealing with the various phases of railway operation which are written by experts in each sphere and contain information which is the result of many years of experience. I also find the articles dealing with railway operating conditions in different parts of the world extremely interesting, while the special numbers dealing with different countries are mines of information.

Mr. N. Yosikura, Engineer, Japanese Government Railways, Tokyo

I am glad to say that your publications, THE RAILWAY GAZETTE and *The Universal Directory of Railway Officials* have always proved an invaluable companion to officials of the Government Railways here, both being annually subscribed to since 1915. Especially we find the *Electric Railway Traction Supplements* issued since 1933 most interesting and valuable for they give us varying useful information as regard electrification of railways. Those especially useful articles in your magazine are rendered into Japanese from time to time and are reported in a journal issued by the Institute of Electrical Engineers here in Tokyo. So far, the Government Railways of Japan have achieved the electrification of 564 km. of railways, which are equipped with 35 sub-stations with a total capacity of 207,500 kW., 164 electric locomotives, 1,383 electric cars and trailers, not to mention those under construction. They intend further to proceed with the work of electrification

Mr. R. B. H. Whitby, Superintendent Commercial, East Indian Railway, Howrah Division, Howrah

Allow me to take this opportunity as a subscriber to congratulate THE RAILWAY GAZETTE on having completed 100 years of continuous publication, and I trust it will complete the next century in as great a style as the last. The main features of THE RAILWAY GAZETTE which I have found most interesting are, briefly:—*Editorials* as a whole, specially the statistics of the British railways weekly traffics; *Scrap Heap*; *Overseas Railway Affairs*—These articles are interesting as they give one an insight into the affairs of other railways outside one's own sphere; *British Railway Statistics*—Prepared in a monthly table of freight and passenger figures, compiled from the Ministry of Transport Statements, these make an interesting comparison with similar statistics maintained on Indian State Railways; and *Railway News Section* (*Personal*)—News under this heading always makes interesting reading, as one is kept in touch with the valuable services rendered to railways by the various railway officials.

XUM

WOULD IT PAY TO ABOLISH FIRST CLASS?

In this article it is contended that it would not pay the British group railways to abolish first class. The direct loss in revenue would be £2,766,154 per annum, and the total possible economies would not amount to more than £1,000,000

THE question of the abolition of classes on passenger trains is one which has been raised from time to time, and the present occasion seems opportune for reviewing the matter once again. From a statistical point of view the case for abolition seems well nigh overwhelming. Even as far back as the early seventies only just over 30 per cent. of the journeys made with ordinary tickets were first and second class, and in the forty years from 1871 to 1911 the percentage dropped to less than 4. The following table, which gives the number of passengers carried at intervals of 10 years from 1871 to 1911 inclusive, brings out the salient facts. It will be observed that during this period first class passengers declined by 16 per cent. and second class by no less than 71 per cent., whilst, on the other hand, third class travel increased by 399 per cent. It should be remembered that the Midland Railway Company in 1875 took the bold step of abolishing second class altogether. A few years earlier that company had begun to admit third class passengers to the whole of its trains. This forward policy caused much perturbation among the other railway companies, and it was only gradually that second class began to disappear, the Great Central following in 1892, the North Eastern in 1899, the Great Western in 1910, and the Lancashire & Yorkshire in 1911. Second class disappeared from the Scottish lines in 1894.

Before the present railway accounts and statistics came into being, information in regard to season ticket holders was meagre in the extreme. Up to 1901 not only was there no distinction shown between first, second, and third class in the annual returns issued by the Board of Trade, but the tickets were not even equated to an annual basis. The change to an annual basis started in 1902, and this had the effect of reducing the number of season tickets shown in the returns by two-thirds. A rough estimate, however, indicates that in the forty years season tickets increased by over 1,200 per cent.

If we look at the receipts we find that third class ordinary passengers contributed less than fifty per cent. of the revenue in 1871, but in 1911 the proportion had grown to over 86 per cent. These figures again exclude season ticket holders. In this same period first class receipts diminished by 13 per cent. and second class by 63 per cent., and, at the same time, third class receipts increased by 324 per cent. and season tickets by 545 per cent.

The new form of accounts and statistics which came into use in 1913 enables us to divide season ticket holders into classes. It is customary to assume that the average season ticket holder makes 600 journeys per annum, *i.e.*, a journey out and home on 300 days of the year, and on this basis the table of first, second, and third class journeys made in 1913, 1923, and 1933 has been made up. For the first time also journeys made with workmen's tickets are separately distinguished from third class. By 1933 first class journeys had fallen to less than 3½ per cent. of the total, second class to just over 1½ per cent., the remaining 95 per cent. being third class and workmen. As regards receipts, first class in 1933 contributed less than 9 per cent. of the total, and second class less than 1½ per cent.

Is it worth while maintaining separate accommodation for first and second class passengers whose contribution to passenger revenue is only ten per cent. of the total?

Only three of the four main line group companies retain second class accommodation, the G.W.R. having abolished it entirely. The L.M.S.R. earned only £2,063 in 1934 from second class passengers, both ordinary and season, and, presumably, retains this class only under agreement

PASSENGERS CARRIED ON RAILWAYS IN GREAT BRITAIN

Year	First Class (thousands)	Per cent. of Total	Second Class (thousands)	Per cent. of Total	Third Class and Parliamentary (thousands)	Per cent. of Total	Total (thousands)	Season Tickets (number)
1871	34,523	9·58	76,698	21·27	249,281	69·15	360,502	170,817
1881	36,318	6·00	60,453	9·98	508,633	84·02	605,404	516,000
1891	28,910	3·51	59,182	7·19	735,168	89·30	823,260	1,375,000
1901	33,199	2·90	65,227	5·69	1,047,115	91·41	1,145,541	1,844,000
1911	28,834	2·23	22,573	1·74	1,244,095	96·03	1,295,502	767,774

RECEIPTS FROM PASSENGERS CARRIED ON RAILWAYS IN GREAT BRITAIN

Year	First Class £ (thousands)	Per cent. of Total	Second Class £ (thousands)	Per cent. of Total	Third Class and Parliamentary £ (thousands)	Per cent. of Total	Total £ (thousands)	Season Tickets £ (thousands)	Total Ordinary and Season £ (thousands)
1871	3,884	23·70	4,864	29·67	7,644	46·63	16,392	749	17,141
1881	3,569	16·76	3,099	14·54	14,634	68·70	21,302	1,458	22,760
1891	2,970	11·35	2,218	8·47	20,985	80·18	26,173	2,373	28,546
1901	3,355	9·86	2,863	8·41	27,815	81·73	34,033	3,503	37,536
1911	3,370	8·97	1,810	4·82	32,395	86·21	37,575	4,834	42,409

PASSENGERS CARRIED ON RAILWAYS OF GREAT BRITAIN, 1913, 1923, and 1933

	1913	1923	1933
First Class			
Ordinary ..	25,441,787	21,470,300	12,593,469
Season* ..	62,770,800	79,755,600	37,301,400
Total ..	88,212,587	101,225,900	49,894,869
Second Class			
Ordinary ..	10,256,647	4,055,268	1,649,955
Season* ..	46,289,400	44,295,000	20,221,200
Total ..	56,546,047	48,350,268	21,871,155
Third Class			
Ordinary ..	911,356,950	899,739,450	743,331,829
Workmen ..	255,882,237	310,301,402	259,471,771
Season* ..	241,629,000	412,150,200	362,826,000
Total ..	1,408,868,187	1,622,191,052	1.365,629,600
All Classes			
Ordinary ..	947,055,384	925,265,018	757,575,253
Workmen ..	255,882,237	310,301,402	259,471,771
Season* ..	350,689,200	536,200,800	420,348,600
Total ..	1,553,626,821	1,771,767,220	1,437,395,624

* Season tickets equated on basis of 600 journeys per annum

PERCENTAGE OF TOTAL

First Class			
Ordinary ..	1·64	1·21	0·88
Season ..	4·04	4·55	2·60
Total ..	5·68	5·76	3·48
Second Class			
Ordinary ..	0·66	0·23	0·11
Season ..	2·98	2·51	1·41
Total ..	3·64	2·74	1·52
Third Class			
Ordinary ..	58·66	50·78	51·71
Workmen ..	16·47	17·51	18·05
Season ..	15·55	23·21	25·24
Total ..	90·68	91·50	95·00

RECEIPTS FROM PASSENGERS CARRIED ON RAILWAYS OF GREAT BRITAIN, 1913, 1923 AND 1933

	1913	1923	1933
	£	£	£
First Class			
Ordinary ..	3,629,548	5,393,696	3,064,658
Season ..	1,657,285	3,493,195	1,735,587
Total ..	5,286,833	8,886,891	4,800,245
Second Class			
Ordinary ..	903,119	633,629	363,581
Season ..	583,559	910,795	398,557
Total ..	1,486,678	1,544,424	762,138
Third Class			
Ordinary ..	34,316,299	55,190,949	38,989,090
Workmen ..	1,665,371	4,112,119	3,484,707
Season ..	2,532,621	7,263,377	6,441,700
Total ..	38,514,291	66,566,445	48,915,497
All Classes			
Ordinary ..	38,848,966	61,218,274	42,417,329
Workmen ..	1,665,371	4,112,119	3,484,707
Season ..	4,773,465	11,667,367	8,575,844
Total ..	45,287,802	76,997,760	54,477,880

PERCENTAGE OF TOTAL

First Class			
Ordinary ..	8·01	7·01	5·62
Season ..	3·66	4·54	3·19
Total ..	11·67	11·55	8·81
Second Class			
Ordinary ..	1·99	0·82	0·67
Season ..	1·29	1·18	0·73
Total ..	3·28	2·00	1·40
Third Class			
Ordinary ..	75·78	71·68	71·57
Workmen ..	3·68	5·34	6·39
Season ..	5·59	9·43	11·83
Total ..	85·05	86·45	89·79

PASSENGER RECEIPTS, FOUR GROUP RAILWAYS, 1934

	L.M.S.R.	L.N.E.R.	G.W.R.	Southern	Total
	£	£	£	£	£
1st					
Ordinary	1,098,210	710,165	421,483	773,862	3,003,720
Season ...	578,935	347,004	101,526	530,901	1,558,366
Total	1,677,145	1,057,169	523,009	1,304,763	4,562,086 9·02 per cent.
2nd					
Ordinary	124	94,296	—	277,768	372,188
Season ...	1,939	406,548	—	—	408,487
Total	2,063	500,844	—	277,768	780,675 1·55 per cent.
3rd					
Ordinary	13,651,531	8,603,609	6,266,852	8,048,996	36,570,988
Season ...	1,769,966	1,000,833	494,435	2,306,685	5,571,919
Workmen ...	1,136,017	640,865	319,543	979,009	3,075,434
Total	16,557,514	10,245,307	7,080,830	11,334,690	45,218,341 89·43 per cent.
Gross Total	18,236,722	11,803,320	7,603,839	12,917,221	50,561,102

EARNINGS PER SEAT, FOUR GROUP RAILWAYS, 1934

	L.M.S.R.	L.N.E.R.	G.W.R.	Southern	Total
	£	£	£	£	£
First Class ..	12·94	13·71	13·35	18·38	14·40
Second ,, ..	1·25	10·87	—	717·75	16·23
Third ,, ..	17·58	18·25	22·68	34·75	21·11
Total ..	16·99	17·25	21·65	32·49	20·17

PASSENGERS PER SEAT, FOUR GROUP RAILWAYS, 1934

	L.M.S.R.	L.N.E.R.	G.W.R.	Southern	Total
First Class ..	124	152	82	213	146
Second ,, ..	153	446	—	969	440
Third ,, ..	442	450	473	989	532
Total ..	403	417	430	850	481

XUM

or compulsion. The Southern Railway restricts second class to its Continental services, and carries no second class season ticket holders. Its receipts from second class traffic last year were £277,768. The L.N.E.R. retains second class on its Great Northern and Great Eastern suburban services, and more than four-fifths of its second class revenue is from season ticket holders. The total is just over £500,000 or 5 per cent. of the total L.N.E.R. passenger traffic.

If we look at the number of seats (or berths) provided by the four companies in relation to the journeys made we find the average annual numbers of passengers per seat in 1934 to be as follow:—

First class	146	Third class	532
Second class ..	440	All classes	481

This calculation is again on the assumption that season ticket holders make 600 journeys per annum.

The G.W.R. seems to be the most lavish in providing first class accommodation, the average number of passengers per seat being only 82, as against 124 on the L.M.S.R. 152 on the L.N.E.R. and 213 on the Southern.

In second class the L.M.S.R. carries in the course of the year 153 passengers per seat, the L.N.E.R. 446, and the Southern no fewer than 969. The last named company has reduced its number of second class seats to 387.

In third class the average number of passengers per seat is very similar in the case of three of the companies, L.M.S.R. 442, L.N.E.R. 450, and G.W.R. 473, but the Southern average is more than double that of any of the other companies, namely, 989.

If we look at the average earnings per annum per seat provided we find that first class does not yield so much as third, and there is great fluctuation in the figures for second class, ranging from £1·25 on the L.M.S.R. to £10·87 on the L.N.E.R., and £717·75 on the Southern Railway. Having regard to the fact that third class accommodation is cheaper to provide than either first or second class it is clear that greater profits are made by the railway companies from a third class passenger than from a first class passenger for the same length of journey.

One other set of figures should perhaps be looked at, namely, those relating to passenger-miles which are taken out by the railway companies from time to time, usually in the month of September, which is generally regarded as a typical average month for the year. The following table gives particulars in respect of each class for 1924 and 1934 showing Journeys, Passenger-Miles, Average Distance per Journey, Receipts, and Receipts per Journey and per Passenger-Mile. It will be observed that in the ten years interval first class passenger-miles have fallen

PASSENGER MILES AND JOURNEYS, AVERAGE DISTANCE TRAVELLING, RECEIPTS AND RECEIPTS PER JOURNEY AND PER PASSENGER MILE ON THE RAILWAYS OF GREAT BRITAIN IN THE MONTHS OF SEPTEMBER, 1924 AND 1934

	First Class		Second Class		Third Class and Workmen		All Classes	
	1934	1924	1934	1924	1934	1924	1934	1924
Journeys								
Ordinary ..	1,016,894	1,824,298	140,612	266,164	75,738,907	80,404,982	76,896,413	82,495,444
Workmen ..	—	—	—	—	23,673,153	26,799,014	23,673,153	26,799,014
Season ..	3,006,827	6,223,247	1,532,981	2,403,508	31,634,478	33,225,035	36,174,286	41,851,790
Total ..	4,023,721	8,047,545	1,673,593	2,669,672	131,046,538	140,429,031	136,743,852	151,146,248
Passenger Miles								
Ordinary ..	36,970,682	55,273,310	4,057,900	6,516,890	1,297,491,526	1,356,481,357	1,338,520,108	1,418,271,557
Workmen ..	—	—	—	—	179,905,951	162,437,132	179,905,951	162,437,132
Season ..	62,721,758	122,230,121	11,524,422	16,569,889	353,415,634	343,556,493	427,661,814	482,356,503
Total ..	99,692,440	177,503,431	15,582,322	23,086,779	1,830,813,111	1,862,474,982	1,946,087,873	2,063,065,192
Average Distance—Miles								
Ordinary ..	36·36	30·30	28·86	24·48	17·13	16·87	17·41	17·19
Workmen ..	—	—	—	—	7·60	6·06	7·60	6·06
Season ..	20·86	19·64	7·52	6·89	11·17	10·34	11·82	11·53
Total ..	24·78	22·06	9·31	8·65	13·97	13·26	14·23	13·65
Receipts								
Ordinary ..	£259,384	£517,953	£32,581	£55,738	£4,018,090	£5,913,560	£4,310,055	£6,487,251
Workmen ..	—	—	—	—	£353,334	£355,940	£353,334	£355,940
Season ..	£138,071	£275,721	£32,162	£43,353	£596,718	£598,140	£766,951	£917,214
Total ..	£397,455	£793,674	£64,743	£99,091	£4,968,142	£6,867,640	£5,430,340	£7,760,405
Receipts per Journey								
Ordinary ..	5s. 1·22d.	5s. 8·14d.	4s. 7·61d.	4s. 2·26d.	1s. 0·73d.	1s. 5·65d.	1s. 1·45d.	1s. 6·87d.
Workmen ..	—	—	—	—	3·58d.	3·19d.	3·58d.	3·19d.
Season ..	11·02d.	10·63d.	5·04d.	4·33d.	4·53d.	4·32d.	5·09d.	5·26d.
Total ..	1s. 11·71d.	1s. 11·67d.	9·28d.	8·91d.	9·10d.	11·74d.	9·53d.	1s. 0·32d.
Receipts per Passenger Mile								
Ordinary ..	1·684d.	2·249d.	1·927d.	2·053d.	0·743d.	1·046d.	0·773d.	1·098d.
Workmen ..	—	—	—	—	0·471d.	0·526d.	0·471d.	0·526d.
Season ..	0·528d.	0·541d.	0·670d.	0·628d.	0·405d.	0·418d.	0·430d.	0·456d.
Total ..	0·957d.	1·073d.	0·997d.	1·030d	0·651d.	0·885d.	0·670d.	0·903d.

by nearly 50 per cent. and second class by 33 per cent., whilst third class have not declined by as much as 2 per cent. In all classes the average distance travelled per journey has increased very largely, due no doubt to the diversion to road of many short distance journeys previously performed by rail.

The payment per passenger-mile (estimated of course in the case of season tickets) has declined in all cases except in respect of second class seasons. In this case for some reason not apparent the payment has increased from 0·628d. to 0·670d. per mile. It is also to be noted that in 1934 second class passengers on the average paid a higher rate per mile than first class. Speaking broadly it may be said that at the present time both first and second class passengers pay on the average a penny a mile for railway travel and third class passengers at the rate of two thirds of a penny a mile, and that in the past ten years the cost of passenger travel has fallen by about 25 per cent., that is, from 0·903d. a mile to 0·670d.

We have now to consider the financial effects of the abolition of first and second class, that is, to compare the loss which would be sustained by the abolition of these classes with the economies which might be expected to be effected by the abolition.

First, as to the loss in revenue. This might arise in two ways:—

(1) The diversion of passengers to road; and
(2) The payment of a third class instead of a second or first class fare.

Taking the year 1933 the receipts from first class passengers amounted to £4,800,245. Let us assume that 10 per cent. would be diverted to road. This would involve a loss of £480,000. Of the remaining 90 per cent. paying ordinary fares there would be a loss of $\frac{941}{1,684}$, and of the 90 per cent. paying season ticket fares a loss of $\frac{123.}{528}$ These two cuts in charges would amount to £1,541,227 and £363,895 respectively. Second class passengers would probably keep to rail, and the loss may be assumed to be only in respect of the reduction in fare. Second class passengers paid in 1933 £762,138, and the loss in respect of ordinary traffic would be $\frac{1,184}{1,927}$ of £363,581, and in respect of season ticket traffic $\frac{265}{670}$ of £398,557, amounting to £223,394 and £157,638 respectively.

The total direct loss in revenue which might be expected would be, therefore, £2,766,154.

This loss might, however, be increased very considerably if the most influential section of the travelling public was antagonised by the abolition of first class accommodation, and it retaliated by diverting traffic from rail to road. Such diversion might have far-reaching consequences.

There would also be a demand for some kind of reserved accommodation even if first and second class carriages as such disappeared. One can hardly visualise the complete abolition of the first class sleeping car, and the experience of running Pullman trains, where supplementary charges are made, indicates that there are a good many people in this country who are willing to pay higher fares than the ordinary for the purpose of obtaining superior comfort in travel or for the privilege of exclusiveness. It is indeed a moot point as to whether the British public is prepared at the present time to rid itself of tradition and to regard all men as equally welcome as fellow travellers.

A demand for a general improvement in third class accommodation would almost inevitably be forthcoming, and this demand could hardly be resisted, having regard to the improvements which have been made in the past, and are still being made, to the third class carriages, particularly on main lines.

There is evidence that the reduction in charge for a first class travel at other than the standard fares, which took effect at the beginning of this year, has been successful in encouraging a good many passengers to transfer from third to first, and it may be assumed that the retention of second class in its present limited form is justified by the results obtained.

On the other hand, there are certain definite advantages which would result from having only one class of carriage, and the point to consider is whether the economies which would accrue are likely to exceed the losses in revenue.

As a preliminary point, it might be suggested that even though there is some slight reversion to first class travel it is only temporary, and the downward tendency will in the course of time re-assert itself. As regards second class, it now remains only for London suburban and Continental traffic.

It is clear that one uniform class would make for greater simplicity both from the point of view of the railways and of the travelling public, and railway practice would be brought into line with road practice where no class distinctions are to be found in the public service vehicles. Even on the railways, there are today quite a number of branch lines which are worked wholly or partly by railcars of uniform class, and this innovation has been introduced without much demur.

Simplicity would lead to economy in innumerable ways; the difficulty is to put a money value on it. The two main economies would probably be in carriage maintenance and locomotive coal consumption due to a reduction in the weight of trains. The maintenance and renewal of carriages in 1934 cost the four main line companies £5,376,633. This figure included horse boxes, and carriage trucks, &c. The aggregate number of seats provided was 2,506,471 and the cost of maintaining each seat may be put at approximately £2 per annum. There were 316,702 first class and 48,099 second class seats. The latter would probably still be required for the second class passengers who would travel third, but assuming it were possible to abolish 75 per cent. of the first class seats, say in round figures 240,000 and that each first class seat cost £2 10s. per annum, to maintain or 25 per cent. more than the average, the total ultimate saving to be realised would be £600,000 per annum.

As regards coal consumption, the locomotive coal bill of the four group companies in 1934 was £10,276,118. Based on engine mileage about 50 per cent. of the cost may be attributed to passenger trains. Uniformity of class should reduce the average weight of trains by say 10 per cent. and assuming that this reduction would lead to a 5 per cent. reduction in coal consumption there would be a saving of approximately £250,000.

Other savings which would be likely to result are:—

Ticket inspection to prevent passengers travelling in a higher class.
Restaurant cars, waiting rooms and refreshment rooms.
Clerical labour and accountancy.
Reduction in time lost by trains having to draw up twice at stations and avoidance of necessity for lengthening platforms.
Reduction in time occupied in marshalling trains.
Reduction in stocks of carriage equipment.
Reduction in cleaning and lighting and lubricating of vehicles.

It would be well nigh impossible to put a money sum to all these economies, but taking £150,000 as the aggregate it will be seen that the total possible economies from all sources would not be likely to amount to more than £1,000,000 per annum or hardly more than one third of the potential losses.

The case for the retention of first class would appear, therefore, to be stronger than that for its abolition.

(*Editorial comment on page* 44)

XUM

THE WEAR OF STEEL RAILS

Summary of a paper read on July 6 by Dr. A. McCance, D.Sc., Chief Chemist to Colvilles Limited, at the summer meeting of the Permanent Way Institution

IN this paper the author first discussed the conditions which produce rail-wear. Essentially a surface problem, the forces which are chiefly responsible for causing wear are twofold. There is the sliding of one surface over another against the effects of friction, and the pressure, at right-angles to the rail surface, of the rolling load. Thus it is reasonable to suppose that the effects of any kind of wear are a combination of the effects of friction and rolling, which can be resolved into these two components. In normal running conditions, the action of a wheel on a rail consists largely of pure rolling, together with a variable amount of slip along the surface. The latter will vary with the relative roughness of the surfaces in contact, with the presence of grease, oil, or water on the rails, and with fluctuations in tractive effort.

Immediately under the wheel, when it is rolling along the rail without slip, the steel is deformed elastically by the pressure. The successive passage of many wheels over the same spot thus subjects the rail to a repetition of stress, and metal in such conditions may suffer from fatigue. There is a limit, depending on the intensity of the stress, which the steel will withstand before it breaks down. If cracks develop, they will do so at the surface, where the stresses are greatest, penetrating at an angle, probably, along the lines of shear. Thus minute pieces of steel will become detached or flattened out by the rolling action, and cause loss of weight, or wear. The diameter of rolling stock wheels is not without its influence in this connection. For a standard size of wheel there is little difference in the rolling wear of the rail up to the point when the rail is stressed to its fatigue limit. But with an increase of load, or reduction in the size of the wheel, the fatigue limit is passed, and wear rapidly increases. The steels that give the best resistance to rolling wear are those which possess the highest fatigue limit, which may be taken as proportional to the tensile strength or the Brinell hardness number. This is seen in the manufacture of ball bearings, in which almost pure rolling takes place, and the quenched 1·0 per cent. carbon, 1·5 per cent. chromium steel, successfully used in their manufacture, is one of the hardest known. But in the rail, which owing to the manner of its support must be resistant to tension as well as compression, some of the hardness must be sacrificed for toughness, so that, under tension, the steel will yield and flow without cracking in the event of the tension stress exceeding the yield point.

Reference was then made to test machines designed to reproduce the practical conditions giving rise to wear, and the author commended the Amsler machine, in which two discs of the material are rotated, one at a speed 10 per cent. greater than that of the other, and pressed together by a force which can be varied. The pressure is intended to reproduce in some measure the rolling load, and the difference in speed represents the slip. This machine has shown that wear increases with the reduction of hardness, and that with mild steels the soft ferrite areas get rolled or squeezed out, so roughening the surface, adding a hammering effect as the wheels jump the hollows, and producing incipient corrugation. A smooth surface steel for rails is therefore desirable, and in this connection the author commends the much greater value of a manganese content of 1·0-1·3 per cent., as compared with only 0·8-1·0 per cent., in producing a homogeneous structure with a larger proportion of pearlite. The rate at which the rail is cooled after manufacture will also affect its wearing capacity, and the author considers that slowly-cooled rails may be expected to wear more rapidly than quickly-cooled rails. In the quenched state, after accelerated cooling, the rate of wear decreases rapidly, and especially as the carbon content, which makes the rails more susceptible to the treatment, is increased. One disadvantage of ordinary manufacturing methods is the decarburisation of the outer surface of the steel, which is readily deformed and crushed up under the load, and temporarily increases the rate of wear in the early life of the rail.

The author next discussed the problem of corrosion, which is known seriously to reduce the fatigue strength of steel. Steels under corrosive conditions will, if exposed long enough, break under relatively small stresses, and this is believed to be due to the formation of cracks which start from the surface and spread inwards. Corrosion may thus be expected to accelerate wear considerably, and in proof of this some striking illustrations were given from motor manufacturing research. It is for this reason that the life of rails is so greatly reduced in tunnels, where moisture condenses on the rail surface, and probably absorbs sulphur dioxide from the tunnel atmosphere, especially if the tunnel be carrying a dense steam-operated service. The liquid so formed is strongly corrosive. Copper, which is known to increase the resistance of mild steel to acid corrosion, appears to have the opposite effect in the case of high carbon steels, and so offers no assistance. Chromium, in an adequate proportion, offers advantages, and in this connection the author instanced a steel which is now being used in America experimentally for rails in tunnels, containing 0·25 per cent. carbon, 0·25 per cent. silicon, 0·69 per cent. manganese, and 2·89 per cent. chromium, which gave a breaking strength of 79·6 tons per sq. in. in the tensile test, with 14 per cent. extension in 2 in., and 32 per cent. reduction of area. The Brinell hardness number was 370. Such a rail would necessarily be expensive, but might prove an economic proposition where corrosion conditions are severe.

The author next discussed the problem of sliding wear, concerning which and its effects relatively little is known apart from the obvious effects of lubrication. He pointed out that the surfaces of metals exposed to the atmosphere are never clean—they become coated with thin films of oxide. These thin films are mostly invisible, but they have a marked effect on the rate of wear, and it is through not taking account of them that so many contradictory results have been reported in wear experiments. Tests on an Amsler machine have shown that *when oxide films have been prevented from forming, the rate of wear has greatly increased.* Thus a steel which will form such a film rapidly should wear well, and so the composition of good wearing steels in the future may be very different from those of today. This may account for the good wearing qualities of an otherwise extraordinary German rail composition containing 0·10 per cent. carbon, 0·40 per cent. silicon, 1·30 per cent. manganese and no less than 0·18 per cent. phosphorus, which, though having a breaking strength of only 37·5 tons per sq. in., with 20 per cent. extension and 55 per cent. contraction, has worn only to the extent of 70 to 80 per cent., as compared with normal rails. The ready oxidation of phosphorus probably accounts for this remarkable result.

(*Editorial comment on page* 45)

RECENT PRACTICE IN TESTING OF BRIDGES IN INDIA

Part III—Describing various tests in Class 3, inclusive of impact allowances, the effect of braking forces on piers and abutments, hammer blow and lurching of locomotives, track irregularities and the deformation of long span trusses*

CONSIDERABLE work has been done in India during recent years on different bridge problems involving tests, three of which fall into Class 3, and are:—

1.—Impact allowances.
2.—Allowances for effect of tractive and braking forces on piers and abutments.
3.—Deformation stresses in large trusses.

Impact Allowances

It is only comparatively late in the history of railways that systematic investigations on a considerable scale into the question of impact have been undertaken. The Royal Commission appointed in 1849 to inquire into the application of iron to railway structures studied the subject in some detail and experimented both on models and actual bridges. It confined its attention, however, to one part of the impact effect, namely, the effect of the sudden application of the load, which is now known to be of relative unimportance in comparison with impact stresses due to other causes. From that time very little was done until the appointment of the committee of the American Railroad Engineering Association in 1906, which conducted extensive tests to measure impact effects from 1907 to 1909. The results were published in its Bulletin No. 125d, July, 1910. The committee arranged the causes of impact in order of relative importance, and concluded that for the types of bridge and rolling stock used for the experiments, the periodic force at the engine's driving wheels was the principal cause of bridge vibrations. After the publication of the A.R.E.A. report, investigations were made in England by the Ministry of Transport on Railway Bridges in England in 1920. The outcome of this work was the evolution of the impact formula $\frac{120}{90 + L}$, which was tentatively adopted by the Indian railways, who had up to that time been using for many years the Pencoyd formula $\frac{300}{300 + L.}$ Simultaneously with the English tests, or somewhat earlier, work was begun in India under the direction of the Indian Railway Bridge Committee. The older and cruder forms of extensometers which embodied mechanical levers for recording the strain were soon discarded in favour of the Fereday-Palmer optical instruments. As the work proceeded the Indian covering formula for all effects, $\frac{65}{45 + L,}$ was adopted for broad (5 ft. 6 in.) gauge railways in 1926, and this is still being used in India for bridges carrying traffic at unrestricted speeds.

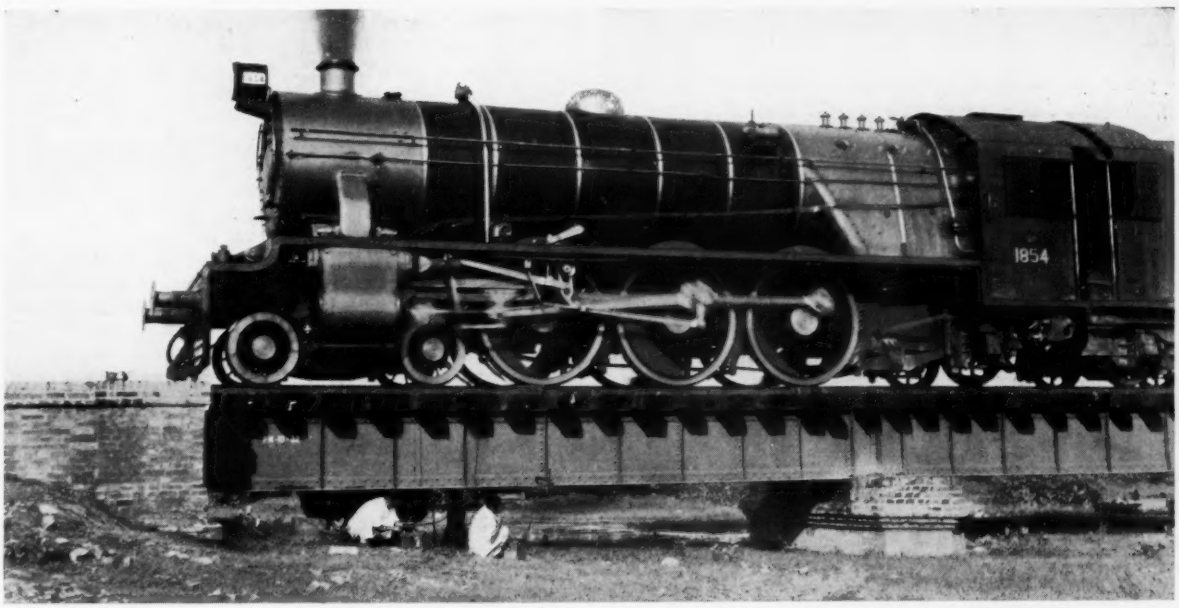

Fig. 24—Slip tests with a heavy 4-6-2 "XC" locomotive on a 30-ft. clear span to check the hammer-blow effect. Note that though the bogie and trailing wheels are stationary, the coupled wheels are revolving rapidly due to slip

Following upon the publication of the report of the British Bridge Stress Committee in 1928, the Indian Railway Board decided to investigate how far the British recommendations could apply to Indian conditions, and this work was begun shortly after the summer meeting of the I.R.B.C. in 1929. The Indian committee was satisfied that its "covering formula" safely covered the effects of total impact on spans of 80 ft. and upwards, but it

* Parts I and II of this series of articles were published in our issues of March 29 and May 31; in them are Figs. 1–23.

XUM

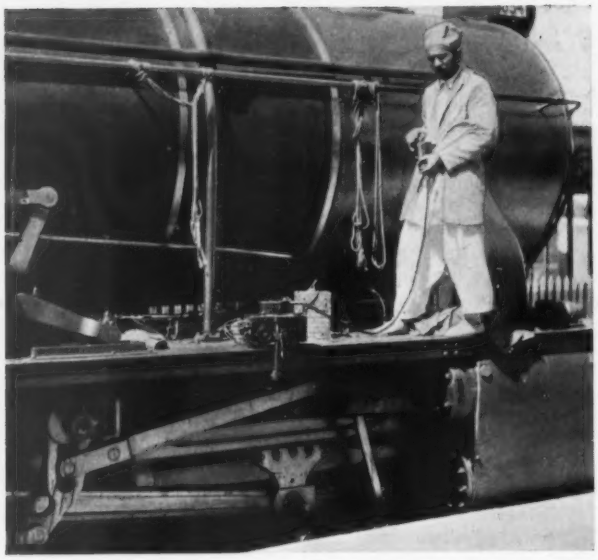

Fig. 25—Fereday optical deflectometer connected to lifting link of Walschaert valve gear to determine rate of slipping of coupled wheels on greased rails of test span

wished to study the effects on small spans of hammer blow, lurching and rail joints.

Effect of Hammer Blow on Short Spans

The reciprocating and revolving masses of the locomotive selected for the tests were weighted statically in the shops and the hammer blow was calculated. This was afterwards checked by running a locomotive across a 6 ft. girder span, first at crawling speed and then at full regulator with the wheels slipping at a measured rate on greased rails, as shown in Fig. 24. Stress recorders attached to the lower girder flanges were used to measure the live load stress during crawl and slip runs, the differences being used to calculate the total hammer blow per wheel, including steam effect.

The effect of impact produced by hammer blow and steam effect was then found on a number of short spans up to 40 ft. clear, under these calibrated engines, by deflectometer (see Fig. 7) and by stress recorder, the steam effect being determined from indicator cards taken on the engine. Fig. 25 shows an "XC" class heavy 4-6-2 type locomotive specially fitted up with a deflectometer, and Fig. 26 shows an HP/S standard 4-6-0 type engine fitted with indicator gear for this purpose. The wire and clay trough method used in early Indian tests to determine the phase of the hammer blows was again adopted. These tests confirmed the British committee's conclusion that hammer blow impact can be calculated by statical methods on spans up to 40 ft.

Lurching of Locomotives

This is the most serious type of oscillation of the spring-borne mass in its effect on the live load vertical bending moment. Pitching is noticeably small on engines with long wheel bases, and vertical oscillation has also been found to be inconsiderable compared to lurch. Its effect on a bridge was first measured by comparing simultaneous stress and deflection records on both girders under the calibrated engines using the clay trough. It was soon realised, however, that a very large number of tests would be required to embrace maximum lurching effect at high speed, and the optical seismograph shown in Fig. 13 was designed and constructed to facilitate these tests.

A number of records was then taken with the seismograph on several of the larger types of locomotive at a range of speeds on bridges with the track in a normal state of maintenance. Fig. 27 shows the seismograph applied to a 4-6-0 HP/S class locomotive on the North Western Railway. When plotted to a speed base, the maximum angle of oscillation on any bridge for a given state of track maintenance is found to be fairly closely in direct proportion to the speed between 25 and 65 m.p.h. The translation of the angle of roll or lurch into terms of increased rail pressure involves a knowledge of the behaviour of the laminated springs under dynamic pulsating forces, and this effect is still being investigated. The lurch can, however, be approximately calculated from the static load deflection diagram for any given roll, and the dimensions centre to centre of running rails and centres of each pair of springs. Increased rail pressure due to lurch of 25 to 30 per cent. of the static wheel load at 60 m.p.h. has been found to be quite common in India under everyday working conditions over bridges.

Rail Joints and Track Irregularities

The effect of these when they occur in short girder bridges in which cross sleepers rest directly on the girder flanges was measured in the following way. Fereday-Palmer stress recorders, specially adapted to work under a condition of fairly rapid vertical acceleration, were attached to the tension flanges of both girders of the test span, and a series of runs from crawl to 60 m.p.h. was

Fig. 26—Indicator gear on 4-6-0 locomotive for bridge tests

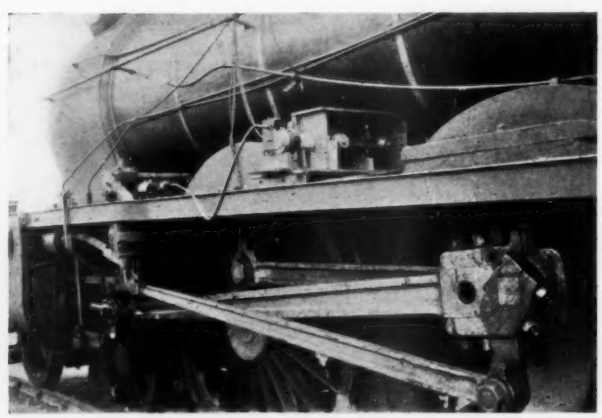

Fig. 27—Optical seismograph fitted for lurching experiments

made with each test engine, first with the running rails continuous across the span and then with a rail joint arranged at mid-span. The phase of the hammer blows was kept constant throughout, this condition being verified by wheel markings in the clay trough. As the steam effect does not vary with speed at the same rate as the hammer blow, it was made negligible by closing the regulator before crossing the span. The increase in the mean recorded stress in a pair of girders at any particular speed after the rail joint had been introduced, enabled the dynamic effect of the joint to be calculated, since lurching and hammer blow effects had been eliminated by taking the mean stress in the pair of girders and by keeping the hammer blow phase constant. The conclusions arrived at from the tests are as follow:—

1.—There is one critical speed for a given value of the unsprung axle load which gives the maximum effect.

2.—The effect of wear at the rail ends is of first importance, and where it is absent the dynamic blow is very small.

3.—Rails hogged at the joint are a prime source of dynamic effect, a defect of $\frac{1}{16}$ in. between joint sleepers at 2 ft. 0 in. spacing, giving rise to a blow of 5 tons per girder at the critical speed. Close spacing of joint sleepers on a bridge is therefore of importance in preventing hogged rails.

4.—The blow increases with some fractional power of the speed and has been taken as 5 tons per girder joint at 60 m.p.h., assuming a good standard of track maintenance.

Allowances for the Effect of Tractive and Braking Forces on Piers and Abutments

The problem of ascertaining the relief afforded by the track to longitudinal forces, which has an important bearing on economical design of piers and abutments, was undertaken by the North Western Railway Bridge Department, who designed special apparatus described in this article. The relief depends upon the relative stiffness of the track and the masonry, if the rail joints are all tightly fished up. In the first series of experiments, the test spans were mounted on roller rocker bearings and were anchored longitudinally to the masonry by a link. Records from stress recorders attached to the link during test runs enabled the longitudinal forces which passed to the masonry via the link anchorage to be determined.

The tests were carried out with varied tightness of fishing, at the joints of both running rails and guard rails (which are fitted to all high bridges). Where guard rails were tightly fished and running rails were loose, the guard rails were 80 per cent. as efficient as the running rails in transmitting longitudinal forces to the abutments. This in itself forms a justification for guard rails. The apparatus used for the earlier experiments was unsuitable for bridges supported on flat plate bearings. The equipment illustrated in Figs. 14 to 18 was then constructed and used on short span bridges supported on flat bearings.

Tractive Effort Tests

By means of the "track link" apparatus shown in Figs. 14 to 16 the axial load passing simultaneously through the rails was measured both ahead of and at the rear of the locomotive as it passed over the test section of the bridge, hauling a full load. In each test, records were taken of the drawbar pull immediately behind the tender by means of Fereday-Palmer stress recorders attached to a specially prepared drawbar fitted to the first wagon. This drawbar is shown diagrammatically in Fig. 17. Braking effect tests were carried out with locomotives only. The track links were again used for these tests, but the braking force was calculated from the deceleration from the time the locomotives reached the test section, when the brakes were applied, until they came to a dead stop. The deceleration was measured by the apparatus shown in Fig. 18 and described on page 611. The displacement curve was drawn from these records and the acceleration curve deduced from it, the braking force at any instant being:—

$$\text{Deceleration in ft. per sec. units} = \frac{\text{Weight of loco. in tons}}{32{\cdot}2}$$

Experiments to Determine the Longitudinal Stiffness of Track

One pair of "track links" was inserted at a joint in a section of ballasted road laid with 90-lb. F.F. rails on bearing plates spiked to softwood sleepers. At this point the fishplates were removed, Fereday-Palmer stress recorders were attached to the links and a dial indicator was fixed to one rail. The adjusting nuts of the links were rotated by hand levers to apply a longitudinal force to the rails, which was measured visually on the stress recorders simultaneously with this change in gap between the rails given by the dial indicator. The stretch modulus was found to be approximately 0·002 in. per ton for a single ballasted track. The investigations of braking and tractive forces applied to the substructures of bridges described above have enabled revised rules to be drawn up and incorporated in the 1933 Indian Bridge Rules, which may be summarised as follows:—

For existing bridges the total traction forces are calculated as 25 per cent. of the driving axle loads of engines actually running or proposed, and brake forces as 20 per cent. of the braked engine axle loads and 10 per cent. of other braked axles running or proposed. The dispersion allowance per track, which may be taken as relief to the masonry afforded by the running rails, can be taken as one-tenth of the weight of the rail in pounds per yard: *e.g.* for 90-lb. rails, dispersion per track is 9 tons. In the case of single span bridges up to 80 ft. clear, these allowances may be increased by 50 per cent.

Deformation Stresses in Long Span Bridge Trusses

During the last four or five years a new method has been introduced in India for fabrication and erection of the main girders of long spans, and this has been adopted as a means of eliminating the secondary or deformation stresses which are induced when the span deflects under dead and live loads. It is usual to specify that sufficient built camber is to be given to the trusses so that the bottom boom shall be straight under full dead and live load deflection. If the main joints are fabricated to give fair holes under zero stress with the total camber, secondary stresses of important magnitude are developed as the span takes its load. If, however, the holes in joints can be drilled to correspond with the profile of the fully deflected truss, secondary stresses will be induced during riveting up under no load, which will dwindle to zero at full load. These requirements have been attained recently in the erection of three or four large span bridges in India, and measurements of actual stresses induced have been made on the East Indian and North Western railways to verify the assumptions and prove the effectiveness of these means of eliminating secondary stresses. To do this, suitable instrument stations were selected on the main girders. Where the girders were plugged to provide fixed measuring points for the determination of the stresses, these were measured by Fereday-Palmer stress recorders at all stages of erection, *i.e.*, before assembling of members and after cambering under dead and full live loads. To eliminate temperature effects, the temperature gauge bar shown in Fig. 12 was used for each investigation. The conclusions were that by the adoption of such special means of erection the primary working stress can be increased from 8 to 9 tons per sq. in.

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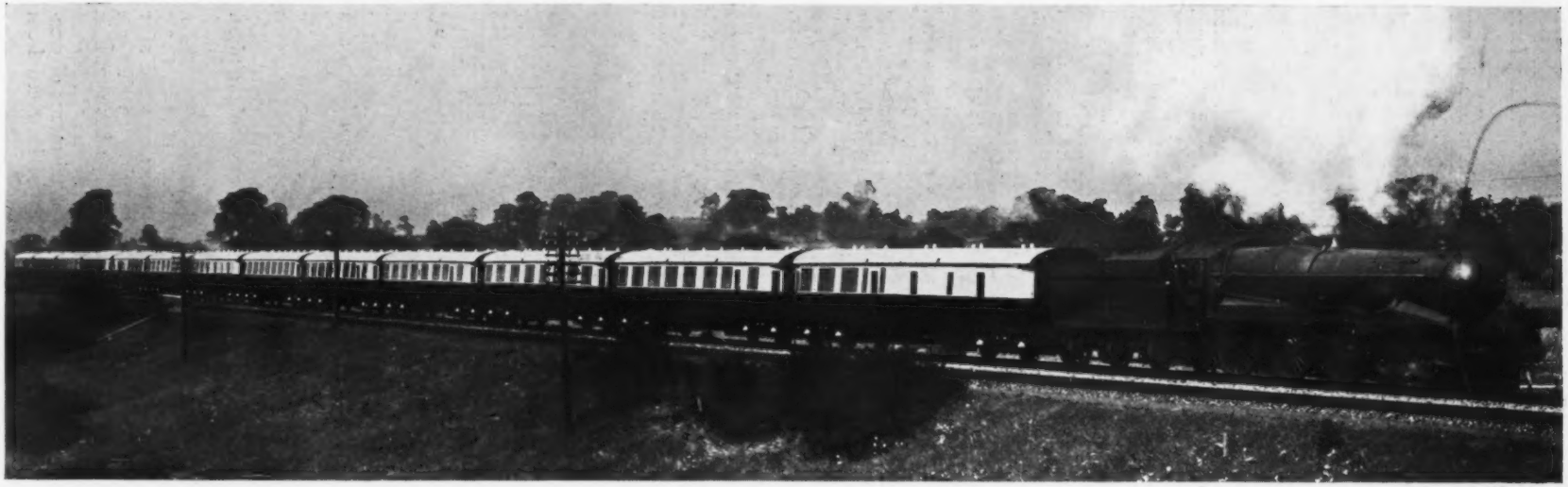
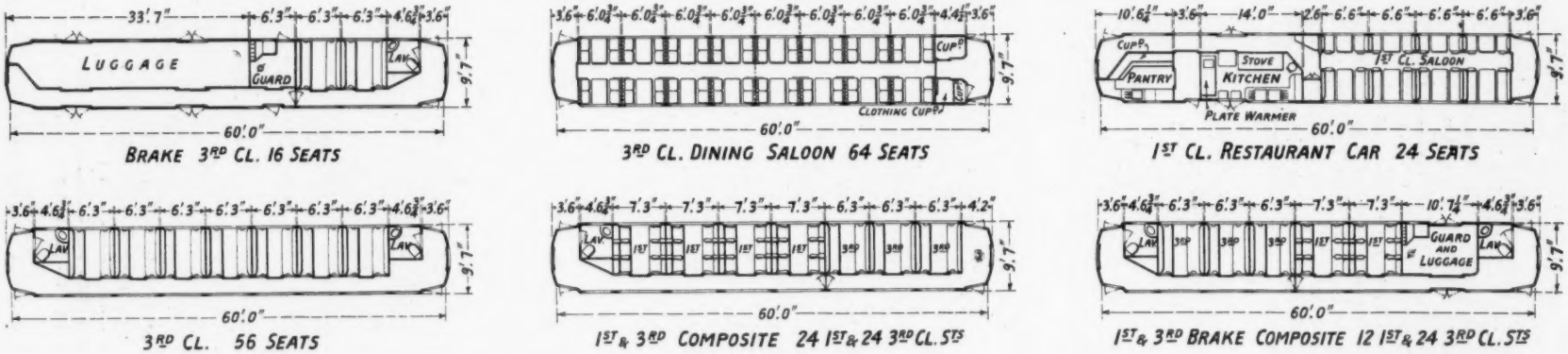
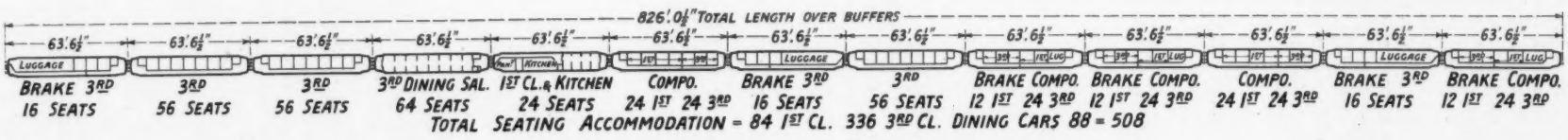


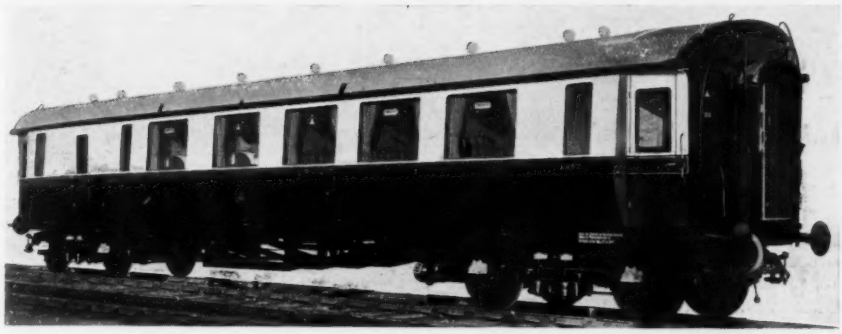
The new train headed by partly streamlined locomotive No. 6014 "King Henry VII".




826'.0½" TOTAL LENGTH OVER BUFFERS
BRAKE 3RD 16 SEATS
3RD 56 SEATS
3RD 56 SEATS
3RD DINING SAL. 64 SEATS
1ST CL. & KITCHEN 24 SEATS
COMPO. 24 1ST 24 3RD
BRAKE 3RD 16 SEATS
3RD 56 SEATS
BRAKE COMPO. 12 1ST 24 3RD
BRAKE COMPO. 12 1ST 24 3RD
COMPO. 24 1ST 24 3RD
BRAKE 3RD 16 SEATS
BRAKE COMPO. 12 1ST 24 3RD
TOTAL SEATING ACCOMMODATION = 84 1ST CL. 336 3RD CL. DINING CARS 88 = 508

Dimensioned diagram of the train showing seating

THE CORNISH RIVIERA LIMITED, GREAT WESTERN RAILWAY. (See page 65)

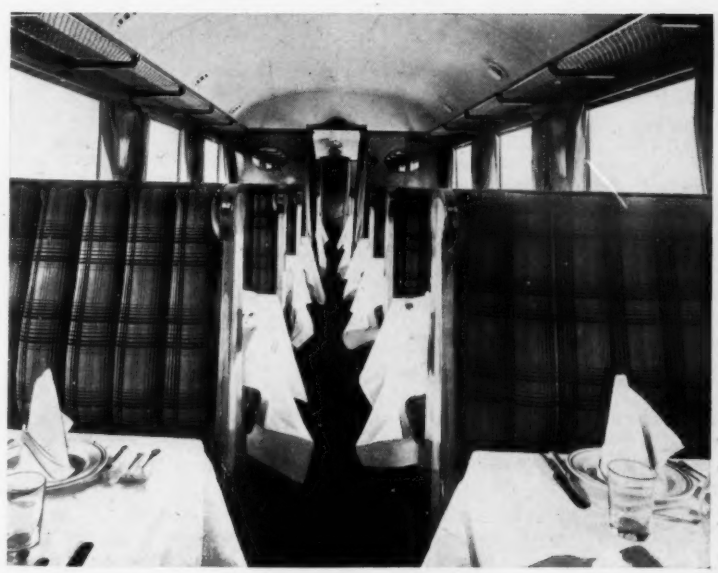


Cornish Riviera Limited, 1935

60-ft. brake composite carriage

First class compartment

Third class compartment



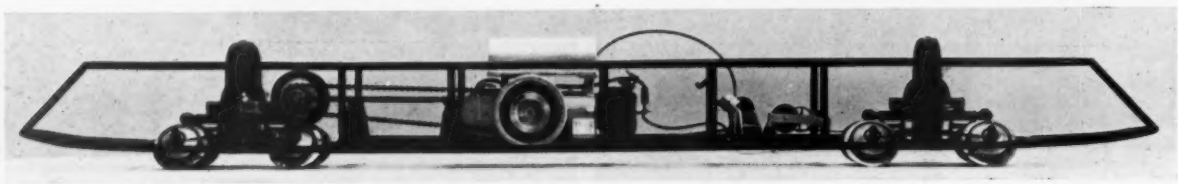
Third class restaurant car

First class restaurant car

SAFETY TRACK FOR HIGH-SPEED RAILCARS

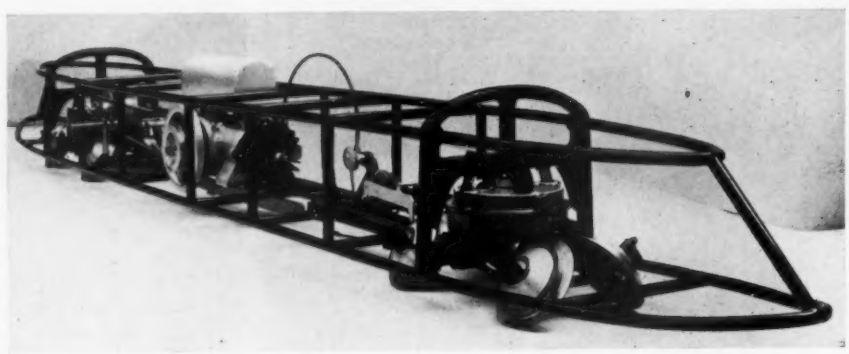
A remarkable design which eliminates the possibility of derailment

IN our issue of May 5, 1933, we gave a short account of a specially designed permanent way and railcar wheel arrangement proposed by Prof. Kurt Wiesinger, of Zurich, for use in connection with high-speed railcars. Recently we had an opportunity of examining for ourselves Prof. Wiesinger's demonstration models, and were much impressed by the potentialities that they suggested.



Side view of an experimental model made by Prof. Wiesinger to illustrate the fundamental principles of his proposed high-speed railcar

Prof. Wiesinger's aim has been to produce a railcar which, while light enough to be capable of speeds exceeding 200 m.p.h. without incurring the use of an abnormally powerful propelling unit, is incapable of being derailed. In order to meet these conditions he has evolved an ingenious form of rail and wheel positioning. This is shown in the accompanying diagram. The rails, instead of being mounted on the sleeper in the orthodox fashion, are inclined at an angle of 30 degrees towards the centre of the vehicle, the wheels of which are also mounted at a similar angle. The running wheels, designed with wide flanges and slightly conical faces, are fitted on independent axle bearings, thus ensuring smoother running on curves than is at present usually the case.



Three-quarter view of experimental model showing general arrangement of the proposed Wiesinger high-speed railcar

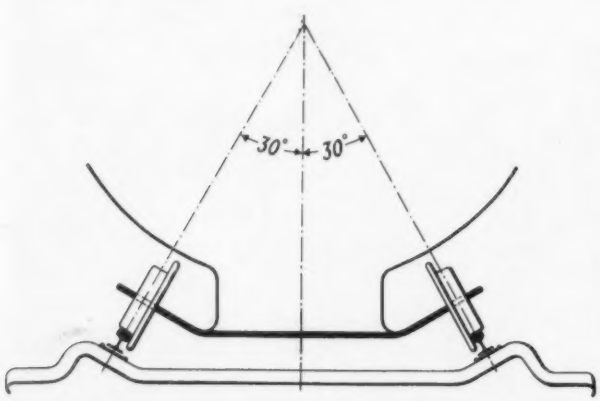


Diagram showing Wiesinger arrangment of running wheels and track

These arrangements should reduce considerably the frictional resistance between the rail and the wheel, and also ensure a positive guidance to the vehicle without any possibility of derailment. This last feature was particularly well demonstrated in the model which we examined, as the track may be turned upside down without the vehicle becoming derailed. This method of track construction, moreover, does not cause any difficulty at points, while gradients exceeding 1 in 20 can be safely negotiated. Curves, as in the case of ordinary track, would have to be suitably superelevated.

Prof. Wiesinger estimates that by using modern lightweight metals in the construction of streamlined railcars built to his specifications it should be possible to reduce the weight per passenger to about 100 kg. With such a reduction in weight he considers it would be possible to operate trains at speeds of 225 m.p.h. The motive power for such high speeds would be supplied by diesel engines, driving air screws, as shown in the illustration reproduced herewith.

Although the cost of converting railway equipment to provide accommodation for Wiesinger cars is admittedly heavy, it is contended that the cost would be only about one-tenth of that involved in electrification. Another factor to be remembered in this connection is that it is not suggested that the system should be adopted except for express passenger services over selected routes. Finally, the permanent way costs of the Wiesinger system should be considerably below those of that at present employed, as the rails used would weigh only 20 kg. a metre instead of the present standard of about 50 kg. a metre.

RAILWAY NEWS SECTION

PERSONAL

Sir Edward Beatty sailed from Southampton on July 6, on his return to Canada.

We regret to record the death, on July 7, of Sir George Touche, Bart., Chairman of the Midland Railway of Western Australia and Vice-President of the British Electrical and Allied Manufacturers' Association (B.E.A.M.A.). Sir George was a Director of the Midland of Western Australia from 1902 to 1918, and from 1918 to 1920 was Deputy Chairman, becoming Chairman in the latter year. Until about 1930 he was also Chairman of the Anglo-Argentine Tramways. He was head of the firms of chartered accountants, George A. Touche & Company of London, Birmingham, Montreal, Toronto, &c., and Touche Niven & Company of New York, &c.

The board of directors of the Madrid Saragossa and Alicante Railway has elected Señor Mariano Marfil to be Chairman in place of the late Señor Juan Alvarado. Señor Marfil, who assumed his new post at the meeting of the board on June 26, has had a long and distinguished political career, and his intimate knowledge of financial questions will be of great value to the M.Z.A. in the present difficult times. Señor Marfil was for several years connected with the leading Madrid daily *La Epoca*.

Mr. George Mills, F.S.S., M.Inst.T., has been elected Chairman of the Scottish Section of the Institute of Transport for the session 1935-36. Mr. Mills, who is Divisional General Manager, Scottish Area, L.N.E.R., is the first railway officer to be elected to the chair of the Scottish Section.

It is with regret that we learn of the death, on July 2, of Mr. W. J. Rich, who retired from the position of District Goods Manager, Shrewsbury, G.W.R., in March, 1926. Mr. Rich began his career on the Cornwall Minerals Railway (later absorbed by the G.W.R.), and subsequently held a number of appointments on the Great Western at London, Reading, Exeter, and Shrewsbury. Being keenly interested in social and municipal affairs, he was a member of the Shrewsbury Town Council and, after his retirement, of the local council at St. Austell.

We regret to record the sudden death, on July 7, of Sir Hugh Reid, Bt., C.B.E., V.D., D.L., LL.D., M.Inst.C.E., Chairman and Chief Managing Director of the North British Locomotive Co. Ltd. Born at Manchester in 1860, Sir Hugh was the eldest surviving son of the late Mr. James Reid, who was sole proprietor and Director of the Hyde Park Locomotive Works, Glasgow, and whose remarkably diverse interests are shown by his being President of the Institution of Engineers and Shipbuilders in Scotland, and of the Royal Glasgow Institute of the Fine Arts, as well as Dean of Guild of the City of Glasgow. Sir Hugh was educated at the Glasgow High School and University, and served a five-years' apprenticeship (1876-81) in the Hyde Park Works; he had thus been nearly 60 years in the locomotive industry. He was admitted to partnership with his three brothers in 1893 and became senior partner on the death of his father a year later. He was largely responsible for the amalgamation of the three great Glasgow locomotive building concerns early in this century as the North British Locomotive Co. Ltd., then the largest in Europe, and was joint designer of the Reid-Ramsay turbine locomotive, in 1909. Outside his own business he was Chairman of the Machine Section at the Glasgow International Exhibition in 1901 and was Lt.-Col. in the Lanark Royal Engineers (Volunteers), earning the V.D. and retiring in 1903. From 1908-20 he was Vice-Chairman of the Glasgow Territorial Force Association. During the war Sir Hugh was a member of the management board for munitions supply in the West of Scotland. His practical interest in Red Cross work during the war was recognised by the bestowal upon him of the C.B.E., and he also received the honorary freedom of the City of Glasgow (1917) and the honorary degree of LL.D. from Glasgow University (1919). He was a Director of the Clydesdale Bank, and, like his father, has also been Dean of Guild of Glasgow: he was moreover, a prominent member of the Royal Company of Archers, the King's Bodyguard in Scotland. Sir Hugh, who by then had become Chief Managing Director and Deputy Chairman of the North British Locomotive firm, was created a Baronet in January, 1922.

The late Sir Hugh Reid, Bt., C.B.E., V.D., D.L., LL.D., M.Inst.C.E.,

Chairman and Chief Managing Director, North British Locomotive Co. Ltd.

Mr. P. J. Smith, Rates Assistant to the Chief Goods Manager, G.W.R., retired from the service on June 29, on account of ill-health. He has been succeeded by Mr. S. H. Creebo.

Mr. L. Meara, Assistant to the Cartage Manager, Southern Scottish Area, L.N.E.R., has been appointed Cartage Manager of that area, in place of Mr. D. McDougall, whose death we announced in our issue of June 14.

Indian Railway Staff Changes

Lt.-Col. W. Macrae, R.E., Chief Engineer, N.W.R., has been permitted to retire from Government service as from May 27.

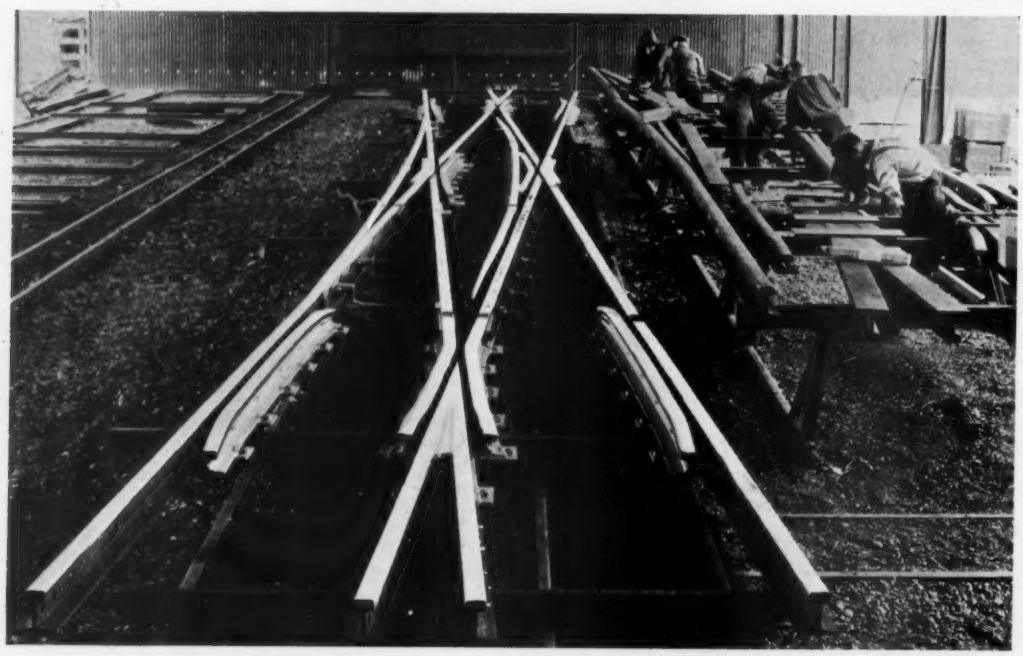
Mr. A. H. Thackwell has been appointed to officiate as Deputy Chief Mechanical Engineer, E.I.R., as from April 30.

Mr. F. C. Langdon has been appointed to officiate as Deputy Chief Engineer, Construction, G.I.P.R., as from May 11.

Lt.-Col. H. L. Woodhouse, M.C., R.E., and the Hon. H. T. de B. Bingham have been promoted permanently as Deputy Chief Engineers, State Railways.

XUM

Southern Railway electrification extension to Eastbourne and Hastings. Opening ceremony by the Lord Mayor of London, at Eastbourne, July 4, 1935



Fabricating crossings by arc welding, on the New Zealand Government Railways. On the right, the bottom flanges of the check rails are in process of being welded to the bed plates

(*See paragraph on page* 50)

Opening of the Southern Railway Electrified Extension to Eastbourne and Hastings

On Thursday, July 4, the Southern Railway's £1,750,000 electrified extension to Lewes, Seaford, Eastbourne and Hastings (see special issue of the *Electric Railway Traction Supplement* for June 28), was officially opened by the Right Hon. the Lord Mayor of London (Sir Stephen Killik, K.C.V.O.), preparatory to the inauguration of the public service on July 7. A special electric train carried a large party of guests over the line, and among those present at the official ceremonies at Eastbourne, Bexhill, and Hastings, were the following:—

Messrs. Kenneth Adam; G. H. Loftus Allen; E. A. Ashton; C. F. Bannister; W. T. de B. Barwell; E. P. Leigh Bennett; A. Berriman; W. Bishop; A. J. Boyd; H. R. Brand; Lt.-Col. P. M. Brooke-Hitching; Messrs. S. H. Busch; W. E. Bussey; J. H. Chillman; Sir George L. Courthope; Mr. E. C. Cox, M.V.O.; Sir Francis H. Dent, C.V.O.; Mr. R. Duckworth; Rt. Hon. Lord Ebbisham; Messrs. J. B. Elliot; C. H. S. Ellis; G. Ellson; Lt.-Col. Sir William Forbes; Messrs. E. O. Frank; S. E. Garcke; T. Godfrey; Eric Gore-Browne; Councillor R. Gorringe; Messrs. C. Grasemann; G. H. Griffith; E. A. Gurney-Smith; Lt.-Col. R. V. Gwynne; Lt.-Col. G. L. Hall; Messrs. G. H. Hare Dean; C. V. Hill; R. Holland-Martin; H. Jones; J. A. Kay; J. C. Kenward, Mayor of Lewes; Sir Stephen H. M. Killik, K.C.V.O., The Rt. Hon. the Lord Mayor of London; Messrs. G. O. Kirkpatrick; C. J. C. Latham; A. H. Lingard; C. G. Mainwood; Henry Mansbridge; J. Martinez; Captain Derek Massy; Mr. R. E. L. Maunsell; Sir Thomas McAra; Messrs. W. C. Moore; F. R. Morgan; Sir Charles Langbridge Morgan; Lt.-Col. A. H. L. Mount; Mr. G. H. Nelson; Sir Archibald Page; Mr. J. S. Pearse; Sir Felix Pole; Rt. Hon. The Earl of Radnor; Messrs. A. Raworth; Basil Raworth; A. H. Riley; H. E. Robarts; Charles Sheath; S. W. Smart; Cuthbert W. Stephenson; Gilbert S. Szlumper; Sir Gerald Talbot; Mr. C. F. Taylor; Councillor A. Turner; Messrs. H. E. A. Twyford; Magnus Volk; Sir Herbert Walker, K.C.B.; Messrs. H. E. O. Wheeler; A. White; F. H. Willis; A. H. Wilson.

The Mayor of Eastbourne (Councillor Miss E. M. Thornton, J.P.), supported by members of the Eastbourne Council, accorded the party an official reception on the arrival of the special train at Eastbourne, to which Sir Stephen Killik replied. Motor-cars and buses were used to convey the guests to the luncheon given at the Grand Hotel by the Eastbourne municipality, in the course of which Mr. R. Holland-Martin (Chairman of the Southern Railway), in replying to the toast of "Success to the Southern Railway's Electrification," mentioned the exceptionally favourable results obtained by the previous conversion of the Brighton line. He looked to the Conqueror's Coast—that stretch of land embracing Lewes, Seaford, Eastbourne, Pevensey, Hastings and the surrounding neighbourhood—to show equally good figures.

Leaving Eastbourne by train, the party proceeded to Bexhill, where, after a brief civic welcome, tea was provided by the Bexhill Corporation in the Town Hall, before rejoining the train for the short journey to Hastings. A break of two hours here before dinner was spent by most of the party in gaining an idea of (or renewing acquaintance with) the amenities the town has to offer in the way of amusements and health tonics, and, favoured by weather of exceptional clemency, this provided a pleasant interlude from the more serious business of the day. The official banquet, given by the Corporation of Hastings, was held at the Queen's Hotel, under the Chairmanship of the Mayor, Alderman Arthur Blackman, J.P., who, in welcoming the Lord Mayor of London and the party brought down by the Southern Railway, mentioned that July 4 was a notable day, not only for the fact that it brought electric trains to Hastings, but also because it was Independence Day, and, more important still, because it was his birthday. He believed that the friendly rivalry between the towns on the Conqueror's Coast would still continue, but with more profit to all concerned, by the inauguration of such a frequent service of clean and comfortable electric trains, a service which he hoped would be supplemented at no distant date by the electrification of the direct line to Hastings. After Sir Stephen Killik's reply, Earl de la Warr (Mayor of Bexhill) proposed the toast of "Success to the Southern Railway's Electrification," to which Mr. Holland-Martin replied. The banquet terminated with the toast of the "County Borough of Hastings" by the Lord Mayor of London, and a reply by Mr. St. John Hutchinson, Recorder of the borough.

The special train left Hastings at 9.30 p.m., and after a fast run, with stops at Lewes and East Croydon, reached London Bridge two or three minutes after eleven. The 26½ miles from Hastings to Lewes were covered start-to-stop in 29½ minutes and the train (composed of a new six-car pantry set coupled to a six-car Pullman set) ran very smoothly throughout.

New Rolling Stock for the Cornish Riviera Limited, G.W.R.

(*See illustrations on pages* 60 *and* 61)

On Monday, July 8, the Cornish Riviera Limited left Paddington at 10.30 a.m.,* composed of new and specially constructed rolling stock incorporating features designed to give greater comfort than ever before. There are in due course to be two such trains to provide a daily service in each direction. At the moment only one has been delivered, necessitating the departure from London being confined, so far as the new stock is concerned, to Mondays, Wednesdays and Fridays, the return journey being made on the alternate days. When the second train is delivered shortly, the service (which runs daily) will be by the new rolling stock each day in both directions. The new Limited carries booked seat passengers only, and runs non-stop to Truro (279 miles) on weekdays, except Saturdays when the down train makes St. Erth (299½ miles) its first station stop.

The first class compartments of the new rolling stock are panelled in light quartered oak and walnut with oval mirrors and are upholstered in a luxurious style, various colour schemes in blue, green and brown having been adopted. The third class compartments are panelled in gaboon mahogany and walnut, with oval mirrors, and the upholstery is in brown mcquette. The windows throughout the train are of extra large size, of the drop type, fitted with rayon curtains. The floor covering is of linoleum laid on felt with carpets and rugs to match the upholstery.

The first class restaurant car is finished in light quartered oak and walnut; the saloon seats are fixed, with loose spring filled cushions, and are upholstered in brown repp. The third class restaurant car is panelled in gaboon mahogany and walnut, and has tip-up spring seats arranged in groups of four on each side of the centre corridor.

The kitchen, which is separated from the pantry by a serving vestibule, is lined with stainless steel sheeting. It is equipped with a gas stove, plate warmer and hot water circulator for supplying hot water to the sinks in the kitchen and pantry. Two refrigerator cupboards are fitted, cooled by an electrically operated refrigerating plant carried under the coach. The pantry contains accommodation for the storage of china, cutlery, &c., in addition to wine cupboards, sinks and serving tables.

The train seats 84 first, 336 third class, and 88 dining passengers for a total weight of about 420 tons tare. Each vehicle is 60 ft. 0 in. long and 9 ft. 7 in. wide (the widest stock in use in the country) and has vestibule entrances with overhanging bow ends which reduce the length of the gangway between the vehicles. The bodies are constructed with fire-proof floors and are completely encased in steel plating. They are carried on massive steel underframes mounted on pressed steel bogies of an improved design, which give very steady riding.

* As recorded in THE RAILWAY GAZETTE of June 14, the Cornish Riviera Express is now replaced by the Cornish Riviera Limited at 10.30 and the Cornishman at 10.35 from Paddington.

XUM

Locomotive Engineers at Brussels

A party consisting of some 45 members of the Institution of Locomotive Engineers left London last Friday by the 8.30 p.m. Hook and Antwerp Continental Express *en route* to Brussels, which city this year formed the venue of the Summer Meeting of the Institution. The sea portion of the journey was made on board the L.N.E.R. steamer ***Malines***, a smooth crossing and punctual arrival at Antwerp adding to the enjoyment of the trip. A special corridor coach was provided for the members on the 8.30 a.m. train from Antwerp (Sud Quay) to Brussels, hauled by an ex-German 4-4-0 express locomotive.

An attractive programme had been planned for the afternoon and evening of Saturday, and was preceded by luncheon at the well-known restaurant Rotisserie Ardennaise in the Boulevard Adolphe Max, after which a tour was made of the city in motor coaches accompanied by English-speaking guides, followed by a drive through the Bois de la Cambre and Forest de Soignes to the Château de Groenendael. After tea there the party visited the beautiful park and woods at Tervueren. Dinner was served in the spacious restaurant situated in the centre of the park and which in years past had formed a royal castle.

Sunday was spent at the Brussels Exhibition where the members found much to interest them, especially in the railway traction and machinery halls. Prominent among the locomotives exhibited were the 2-8-2 tank engine with Cossart valve motion of the French Nord, the 2-10-2 4-cylinder compound P.L.M. freight type in which a pair of inside coupling rods are used, the Etat 3-cylinder simple mountain type express locomotive, and the new 4-6-2 semi-streamlined 4-cylinder simple express type of the Belgian National Railways. The Franco 8-cylinder articulated engine was also on view, and in addition a very well produced full-size model of a train of 1835 consisting of locomotive and open and closed carriages. Passenger rolling stock belonging to the Belgian, French, Swedish, and Italian railways was also inspected with interest, together with other types of vehicles including railcars. In the machinery section electric plant, machine tools, turbines, castings in iron and steel, fireless locomotives, firebox tube plates in copper, and much more of the same kind provided the party with a variety of objects deserving attention. Visits were also paid during the day to the British and other sections.

The return journey to London was via Zeebrugge, where the members embarked on the L.N.E.R. steamer *Archangel* for Harwich, London (Liverpool Street station) being reached shortly before 8 o'clock on Monday morning. The weather was consistently fine throughout. The Committee, consisting of Messrs. L. J. Le Clair and H. E. Geer, were indefatigable in their efforts to ensure success; they were ably seconded by M. Hoyoux, Secretary of the Belgian Westinghouse Company, who made the arrangements in advance in Brussels on behalf of the London Committee, and his two English speaking assistants, MM. Bouchams and Cruyt, who acted as guides for the party when visiting the exhibition.

Much valuable work in connection with the meeting both prior to and during the visit was done by the Secretary of the Institution, Major H. A. Harrison.

Those who took part in the meeting included the following:—

W. A. Agnew, W. J. Ash, H. F. Bannister, T. Barty, A. R. Bell, D. C. Brown, H. R. Carver, F. G. Cleaver, A. H. Dudbridge, W. A. Dudbridge, W. S. Edwards, C. Eyers, H. E. Geer, J. N. Gresham, S. R. Gresham, W. H. Grieve, H. A. Harrison, L. Hyde, S. King, Chas. S. Lake, E. Lawton, J. J. Lawton, L. J. Le Clair, M. Lewis, E. E. Lloyd, E. Mason, W. F. McDermid, J. C. Metcalfe, L. A. Mohan, F. H. Pank, A. L. C. Purr, Major S. G. Redman, T. H. Sanders, W. Sinclair, J. G. Smith, A. J. G. Smout, J. H. Streeter, J. F. B. Vidal, H. R. L. Walker, J. Waring, S. A. Webster, M. Weiss, B. White, R. H. Whitelegg, S. H. Whitelegg, W. Cyril Williams, and F. G. Wintour.

The Scarborough Flyer

It was unfortunate that a breakdown should have occurred on the line ahead on the day when the Scarborough Flyer was making its inaugural run to York on the new 3-hr. schedule. Although the train was made up to 12 coaches, which is two vehicles in excess of the 350-ton load contemplated when the schedule was drawn up, time was well in hand as far as Grantham; but the series of signal checks through Newark caused a delay of between 13 and 14 min., which could not be recovered. The actual weight of the train was 402 tare tons, or 420 gross tons, and the engine super-Pacific No. 2747 *Coronach*. As far as Grantham the most remarkable of the work, load duly considered, was that performed uphill. Up the 8 miles at 1 in 200 from Wood Green to Potter's Bar speed fell no more than from 57½ to 54 m.p.h., and was being well maintained at 55 m.p.h. past New Barnet. With the help of a maximum speed of 80 m.p.h. beyond Hatfield, therefore, the remarkable passing time of 33 min. 33 sec. was registered at Hitchin, 1½ min. ahead of schedule, and the engine was then eased somewhat, speed not being allowed to rise above 83½ m.p.h. at Arlesey. But for extreme caution approaching Peterborough, the time to that point would barely have exceeded 71 min. The 62.3 miles from Potter's Bar to Fletton Junction were run in 52 min. 15 sec., at an average of 71·5 m.p.h. Fine work was performed again between Peterborough and Grantham, with a maximum rate of 71 m.p.h. on the level at Tallington, a sustained 68 m.p.h. up the rising grades beyond Essendine, a minimum of 57½ m.p.h. up the lengthy 1 in 200 to Corby, and of 56 m.p.h. up the final 3 miles at 1 in 178 to Stoke. Thus the 20.6 miles from Werrington up to Stoke were run with 420 tons in 19 min. 35 sec., an average of 63.1 m.p.h. and Grantham passed in 101 min. 10 sec.

Then came the unexpected delay at Newark, owing to an engine having failed on the main line ahead; it was finally towed with its train into the sidings, but the loss so sustained by the Scarborough Flyer was between 13 and 14 min., and with so heavy a train there was no possibility of recovering the loss. Again the uphill work was good, with a minimum speed of 60 m.p.h. at Markham, and 64 m.p.h. at Piper's Wood, but the driver only just succeeded in holding his own, and the arrival was 12 min. 19 sec. behind time. The 188·2 miles thus occupied 192 min. 19 sec., but with due allowance for the Newark delays the net time was about 178½ min., and it was clear from the running that with the normal rostered load of 350 tons the booking will give no difficulty.

L.N.E.R. KING'S CROSS–YORK
Engine: Super-Pacific No. 2747, *Coronach*.
Load: 12 coaches; 402 tons tare; 420 tons full.

Distance	—	Schd.	Actual	Speeds
miles		min.	min. sec.	m.p.h.
0·0	KING'S CROSS ..	0	0 00	—
2·5	FINSBURY PARK	—	6 03	—
5·0	Wood Green ..	—	8 59	57½
9·2	New Barnet ..	—	13 29	55½
12·7	Potter's Bar ..	—	17 23	34
17·7	HATFIELD	22	21 48	80
23·5	*Woolmer Green* ..	—	26 42	64½
25·0	Knebworth	—	28 08	*76½
28·6	Stevenage	—	31 01	73
31·9	HITCHIN	35	33 33	—
37·0	Arlesey	—	37 16	83½
41·1	Biggleswade ..	—	40 32	†74
44·1	Sandy	—	42 53	77
47·5	Tempsford	—	45 36	—
51·7	St. Neot's	—	49 08	70
56·0	Offord	—	52 39	74
58·9	HUNTINGDON ..	56	55 08	70
62·0	*Mile-post 62* ..	—	58 16	55
69·4	Holme	—	64 35	79
75·0	*Fletton Junction* ..	—	69 38	64½
76·4	PETERBOROUGH ..	73	71 53	¶20
79·5	*Werrington Junction*	—	76 34	—
84·8	Tallington	—	81 34	71
88·6	Essendine	—	84 53	68
92·2	Little Bytham ..	—	88 13	—
97·1	Corby	—	92 58	‡57½
100·1	*Stoke*	—	96 09	56
105·5	GRANTHAM	102	101 10	¶55
109·7	Barkstone	—	105 23	—
115·4	Hougham	—	109 53	77½
		sig.	stops	
120·1	NEWARK	114	125 55	—
126·4	Carlton	—	132 30	68
133·7	*Markham*	—	139 23	60
135·5	*Gamston*	—	140 56	79
138·6	RETFORD	132	143 35	¶65
143·9	Ranskill	—	148 27	—
147·7	Bawtry	—	151 38	74½
149·5	*Piper's Wood* ..	—	153 12	64
153·2	*Black Carr Jc.* ..	—	156 20	73
156·0	DONCASTER ..	147	158 48	¶65
160·2	*Shaftholme Jc.* ..	—	162 38	—
166·0	Balne	—	167 48	—
169·8	Templehirst	—	171 14	—
174·4	SELBY	164	176 02	¶28
178·5	Riccall	—	181 41	—
184·0	Naburn	—	186 55	71
188·2	YORK	180	192 19	—

Net time: 178½ min.

Permanent Way Institution Summer Convention

Beautiful weather made the annual busman's holiday of the Permanent Way Institution—this year with Glasgow as its centre—an ideal affair. Among those who participated under the presidency of Mr. W. K. Wallace were:

Messrs. N. B. Bates, K. Brinsmead, Cowan, N. C. Davis, J. Dunn, A. W. M. Dyke, M. Frieze, R. W. Gairns, R. Gaudin, Gibson, E. Greenhalgh, G. D. Greig, J. B. Halley, Hepworth, H. Janes, Kirk, J. H. Knotts, F. Lawson, S. E. McLewin, Marshall, J. Melville, A. Newlands, H. F. Russ, W. T. Sandeman, P. Sanderson, D. D. Shaw, W. H. Shortt, Swain, C. F. Tofts, J. Turner, T. H. Turner, E. H. Tustain, W. A. Willox, and L. Wynn-Williams.

The proceedings opened at the Royal Technical College on Saturday afternoon, July 6, with the annual general meeting at which the President, Mr. W. K. Wallace, Chief Engineer, L.M.S.R., took the chair. The record membership of 2,500 was reported. To the post of Honorary Editor of the Journal, rendered vacant by the death of Mr. E. Treacher, Mr. Keith Brinsmead of the L.P.T.B. was appointed. After the presentation of prizes awarded for 1934 papers to Mr. F. S. Jackson, L.N.E.R. (Gold Medal); Mr. T. J. Thomas, L.M.S.R. (Silver Medal); Mr. F. G. Cates, Sudan Government Railways (Bronze Medal); and Mr. L. G. B. Rock, S.R. (book prize); Dr. A. McCance, Chief Chemist of Colvilles Limited, read a paper entitled "Wear in its Application to Steel Rails," a summary of which will be found on page 56, and comment on page 45.

In the evening, Mr. Wallace presided over the summer dinner of the institution at the St. Enoch Station Hotel. Mr. John Craig, Chairman of Colvilles Limited, proposed the toast of "The Institution" to which he thought the best compliment he could pay was to refer to the remarkable safety of the railways. The institution made a feature of co-operation between those who specialised in theory and design and those who made practical application of that knowledge. He believed that the judicious mixture of theory and practice brought about by the willing co-operation which the institution fostered was the key to ultimate success in any undertaking.

Mr. Wallace in reply mentioned that his company, in ordering between 80,000 and 90,000 tons of rail this year, showed how far from achieving the ideal permanent way engineers still were, and how inter-dependent were heavy industries and the railways which served, and at the same time relied upon, these industries. Mr. Wallace referred to Dr. McCance's paper and said that any contributions towards improved wearing qualities would be welcomed by the railways, and need not be feared by the suppliers of rails, for, with the progressive increase in loads and speeds which the permanent way was being called upon to bear, there was little prospect of any diminution in the requirements of new rail. In fact, if the ideal of the commercial departments—which seemed to aim at the starting of a train at say 9.45 to arrive at 9.40—were even aproached, he saw every likelihood of the railways depending more than ever upon the steel makers.

Mr. Arthur R. Cooper, Chief Engineer, L.P.T.B., proposed the toast of the "Lord Provost and Corporation of the City of Glasgow." He complimented Glasgow on its model municipal administration. He had been particularly impressed by the copious supply of soft water drawn from Loch Katrine, nearly 40 miles distant, which placed Glasgow beyond the danger of any possible drought. Mr. Cooper referred to his recent visit to Moscow to witness the inauguration of the first underground railway in Soviet Russia. The building of this railway had been a big undertaking carried out in a workmanlike way, although not with the most modern equipment. Those responsible had, however, the great advantage that expense had been no object, and the result was apparent in the magnificence of the finish. The cost in man-hours had been high because of the inadequacy of the tools and plant available. It had worked out at 2,000,000 man-hours a mile, but everyone appeared to have worked with enthusiasm and certainly had produced a creditable result.

The Lord Provost, Sir Alexander Swan, in replying, said that Glasgow was a little envious of London at the moment in connection with the £40,000,000 scheme for electrification. It was felt that Glasgow should participate in this sort of advantage for there were many lines in the West of Scotland suitable for electrification. He hoped, however, that the Glasgow Corporation and the two great railway companies which served Glasgow would succeed in obtaining some assistance for electrification. Mr. Cooper had mentioned the Glasgow Subway, and had spoken in praise of the new electric service, and particularly of the courtesy of the staff. The Lord Provost hoped that the electrification would soon now be complete and so provide Glasgow with an underground railway which, though not comparable with the most newly constructed, would at least give improved service to travellers and relieve congestion in the streets.

The toast of "The Guests" was proposed by Mr. R. W. Gairns, District Engineer, Glasgow Central, L.M.S.R., and Vice-President for Scotland of the Permanent Way Institution, who paid tribute to the Lord Provost and expressed the thanks of the institution for his honouring the company by attending the annual dinner. He also expressed the gratitude of the members of the Permanent Way Institution to the railway companies for the facilities they had granted to the members during the convention. Mr. John Ballantyne, Chief Officer for Scotland, L.M.S.R., briefly replied on behalf of the guests.

On Tuesday evening the members and their ladies were given a civic reception by the Lord Provost and the Corporation of the City of Glasgow. The convention lasted until Thursday, during which time visits were paid to numerous works and places of interest in the neighbourhood.

Group of members, including Mr. W. K. Wallace, the President, and Mr. R. W. Gairns, Vice-President, taken at Inversnaid [*N. C. Davis* *Photo*]

XUM

The Welwyn Railway Accident

The inquest on the thirteen passengers and a guard, who were killed in the fatal collision on June 15 at Welwyn Garden City, L.N.E.R., was resumed and concluded on Friday last, July 5. Among the railway officers present, additional to Mr. F. C. Scott, of the L.N.E.R. Legal Department, were Messrs. V. W. Barrington-Ward, F. Warriner, and F. Sparke.

As was done at, for instance, the inquest after the Winwick Junction accident on September 26 last, there were exhibited a large diagram of the lines, signals, &c. concerned, block instruments and models of signals. These were explained by Mr. Barrington-Ward, who said that under that system there could be only one train in a section. The signalman at the box in advance had control of the section, and the man in the rear was responsible for not sending a train into the section without the authority of the man in advance, given by the block bell and indicator exhibited. Answering the coroner, the witness said that the human element could come into the question, but so far as possible the human agent was eliminated. In reply to the foreman of the jury, Mr. Barrington-Ward said that if the section had been track circuited right through there could positively have been only one train but such was not the usual practice, on such an open section of line.

Driver Morris and fireman Glenn of the 10.53 from King's Cross—the second portion of the 10.45—then repeated the evidence they gave at the Ministry of Transport inquiry on June 26. They were approaching Welwyn Garden City distant at 65 to 70 m.p.h., when they saw that it was "on." Steam had been shut off and speed reduced when they found that the home and starting signals were at "clear" and they had just resumed speed and were going at about 25 m.p.h. when their train was run into in the rear by the parcels train. But for the check at the distant they would have been well on their way to the North when the parcels train reached the Garden City station.

The driver of the parcels train was Charles Barnes, who testified that when he was approaching Welwyn Garden City distant, at about 65 m.p.h., he saw that it was at "clear," but when he sighted the home signal that signal was at "danger." The fireman also saw it and shouted that it was "on." The red light of the tail-lamp was showing too. He shut off steam, applied the brakes, but there was not sufficient time to avert the collision. Visibility was fairly good. Answering the representative of the National Union of Railwaymen, Barnes said that though they started late from King's Cross they were not expected to make up time. They could have done so if necessary as it was a light train, drawn by a powerful engine. Fireman Frank Jones corroborated his driver's evidence. He added that after the collision he went to the signal box. His only conversation with the man there was to say that the distant was "off." The signalman made no reply as he was engaged at the telephone. Answering the N.U.R. representative Jones said that the man was speaking on the telephone and quite busy three or four minutes after the collision.

Signalman Horace Ball of Welwyn North signal box—the box next in advance to the Garden City—said that up to the time he received the "obstruction; danger" block signal at 11.29 the working on both sides on his box had been quite normal. Signalman Albert Crowe, of Hatfield No. 3—the box next in the rear of the Garden City—testified that at 11.23 he sent the "Is line clear?" signal to the Garden City for the parcels train. It was at once accepted and as he thought that that was quick work he asked on the telephone if 825A—the 10.58—was "out." The reply was "off" so he pulled off for the parcels train and gave train-entering-section at 11.25. At 11.29 he received "obstruction; danger" from Welwyn Garden City.

When signalman Fred Howes, of the Garden City box, entered the witness-box he told the coroner, in answer to that officer's question, that he was willing to give evidence. He said he had been a signalman since 1912 and was transferred to Welwyn Garden City in April last and, after five weeks' instruction there, took charge on May 11. On the night of the accident he came on duty at 10 o'clock. The first portion of the 10.45 passed him at 11.20 and he then accepted the second portion, receiving train-entering-section from Hatfield No. 3 for it at 11.22. He denied giving train-out-of-section for it to Hatfield or the entering-section to Welwyn North at 11.27. Told that the other man said differently and reminded that he was on his oath, Howes replied that he quite understood that. Questioned why he checked the second portion at the distant, witness said he was engaged with other work and did not pull it off immediately. He had no entry in his train register of the Is-line-clear? for the parcels train. He did not receive the train-entering-section for that train; he had no warning at all of it and knew nothing about it. Asked as to a telephone call, Howes said that he remembered Hatfield ringing him up after he had accepted the second portion and being asked if he, Howes, had given "Out," and that he had replied "Yes"; he was referring to the first portion. Asked by the Coroner if he wished the jury to believe that he had no indication at all from Hatfield for the parcels train, the witness said that that was so. In reply to a question as to anything to distract his attention, he said that there was a telephone call, but he was not sure of the time when that happened.

The Coroner, in summing up, said that it was for the jury to decide whether the accident was due to any person's neglect or whether it was an error of judgment or forgetfulness. If they were of opinion that there was neglect amounting to culpable negligence, the person so guilty would be guilty of manslaughter. If they thought it was due to a lapse of memory or an error of judgment and there was no gross or criminal negligence, their verdict should be accidental death. After an absence of 35 minutes the jury returned a verdict of "Accidental death, owing to a temporary lapse of memory and error of judgment on the part of the Welwyn Garden City signalman."

A New L.N.E.R. Paddle Boat

The accompanying illustration shows the new diesel-electric paddle ship, *Talisman*, built for the L.N.E.R. Clyde services by A. & J. Inglis Limited. The vessel represents the first departure from steam propulsion made by the L.N.E.R. in its Clyde fleet. Accommodation is provided for 1,259 passengers, the gross tonnage being 544 tons and the overall length 224 ft. The machinery, both diesel and electric, was constructed and installed by the English Electric Co.

New Insulated Milk Vans, L.M.S.R.

The L.M.S.R. has completed at Derby works two insulated milk vans specially designed for conveyance of milk in churns. Their outside dimensions are 31 ft. by 8 ft.; they are designed to carry six tons, and are mounted on steel underframes of the standard design for six-wheeled carriage stock, equipped with vacuum brake, hand brake with outside levers, through a steam pipe, and screw couplings. Two pairs of insulated double doors with a 5-ft. opening are provided on each side and these are fitted with cam action fasteners and the joints sealed with rubber tubing and Rubo gaskets.

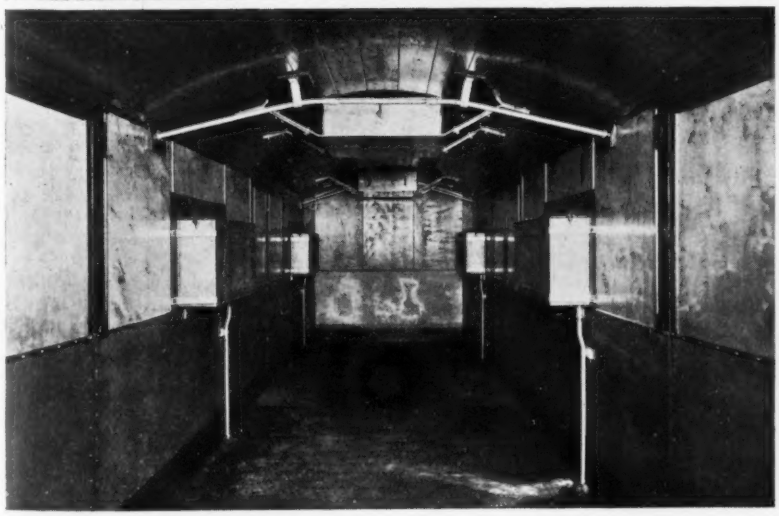
New features in the construction of the body include the special arrangement of the pillars, rails, and roofsticks whereby the framing members and roofsticks carrying the outer panels and roof boards are separate from those carrying the inside panels and ceiling. With this arrangement a more complete insulation from the effects of the outside temperature is obtained. The body side panels are of multi-ply $\frac{5}{8}$ in. outside, $\frac{3}{8}$ in. inside with a space of 3 in. between. With the exception of the door standing and corner pillars, the pillars and rails are 3 in. wide by 2 in. thick, leaving a space of 1 in. between each member and the panels opposite to them, and are arranged alternately and apart from each other. Corrugated sheets of Alfol are arranged in the spaces thus provided, and the insides of the panels and framework are lined with bitumastic paper. The edges of the panels are wrapped with Rexine and the joints covered on the outside with a steel moulding screwed in position and a hardwood moulding for the inside panels.

The roof is constructed on the same principle with outer canvassed roof boards, $\frac{5}{8}$ in. and inside boards, $\frac{3}{8}$ in., both tongued and grooved, with a 4 in. space containing corrugated sheets of Alfol between. The roofsticks are 2 in. square arranged alternately 3 in. apart, and giving a space of 2 in. between each stick and the boards opposite to them. The inside of the inner roof boards and roofsticks are covered with bitumastic paper. The corner pillars are insulated by fitting a board from floor to ceiling arranged diagonally from side to end panels, and the space thus provided lined with Alfol. The van has a double floor consisting of $\frac{3}{4}$ in. tongued and grooved boards and $2\frac{1}{2}$ in. space up to the corrugated steel sheets carrying the bitumastic flooring. The inside of the boards and the floor framing members are lined with bitumastic paper, and the $2\frac{1}{2}$ in. space contains sheets of Alfol.

For hygienic purposes corners have been obviated where possible, the bitumastic floor being finished off with a cove at sides and ends of the van, also the interior of the vehicle is lined up to a height of 3 ft. 2 in. with 24 S.W.G. stainless iron, the top of the panels being covered with a $\frac{3}{4}$ in. convex galvanised iron moulding.

The cooling apparatus inside the van consists of six wet ice bunkers, spaced three on each side, and three Drikold bunkers are also fitted close up to the ceiling; the interiors are connected by $\frac{3}{4}$ in. bore galvanised pipes and brass outlets to the insulation space in the body side and ends. The special construction of the body framework permits a complete circulation and allows the air in the insulation spaces to come in contact with the cooling gas, thus further assisting the Alfol insulation. These bunkers rest on $\frac{1}{4}$-in. thick aluminium plates suspended from the roofsticks; they are insulated with Onozote and the joints sealed by rubber strips. Care was taken in the construction of the vehicles to avoid as far as possible bolts securing ironwork on the body passing from the outside to the inside, and where this is not possible the heads are covered.

These insulated milk vans have been designed by Mr. W. A. Stanier, Chief Mechanical Engineer, L.M.S.R., to whom we are indebted for this description and for the photographs we reproduce.



Exterior and interior views of new L.M.S.R. insulated milk vans

Forthcoming Meetings

July 17 (*Wed.*)—**Great Western of Brazil Railway Co. Ltd.** (Ordinary General), River Plate House, Finsbury Circus, E.C., at 2·15 p.m.

July 19 (*Fri.*)—**Egyptian Delta Light Railways Co. Ltd.** (Annual General), Winchester House, Old Broad Street, E.C., at 12 noon.

July 22 (*Mon.*)—**Leopoldina Railway Co. Ltd.** (Ordinary General), River Plate House, Finsbury Circus, E.C., at 12 noon.

July 24 (*Wed.*)—**Bombay, Baroda and Central India Railway Company** (General), Southern House, Cannon Street, E.C., at 1 p.m.

Forthcoming Events

July 12–15.—Railway Students' Association, at Chancellor's Hall, Augustus Road, Birmingham. Convention.

XUM

MINISTRY OF TRANSPORT ACCIDENT REPORT

Hazelwood, L.M.S.R. : February 20

This station is situated on the Duffield-Kirksworth branch, just north of Derby. It is a single line and is classified on the L.M.S. as a third-class road which, we would remark, is that of a branch passenger line over which speed does not generally exceed 45 m.p.h. and traffic is fairly light. It is 8 miles in length and the gradient, which falls practically continuously towards Duffield—the direction being taken by the train in question—is at an average of about 1 in 170.

The accident was the derailment of a passenger train, consisting of three bogie coaches and a six-wheeled brake van—which was the third vehicle from the engine—and was drawn by an 0-6-0 tender engine, running chimney leading. The first mark of derailment was 900 yards on the Kirksworth, or north, side of Hazelwood station, but it was at a point 100 yards south of the station that the engine and tender, lying on their side, came to rest and all the coaches completely derailed. The driver was killed and the fireman seriously injured ; there were no passengers in the train. The engine was new in 1927 ; it had a general overhaul in September, 1934, and no defects had been reported on the card. Another driver who gave evidence spoke of having found it satisfactory and no defect was detected in the engine after the derailment. There was no speed restriction on the line.

In reporting on the accident, Colonel Trench said that the track in the vicinity of the derailment consisted of 85-lb. rails, in 21-ft. lengths, with 50-lb. chairs secured to the sleepers by 2 spikes and 2 trenails ; the ballast was about 3 to 4 in. of ashes on 2 to 3 in. of old stone ballast. The rails were worn to an average weight of 79 lb., they were laid originally in 1885 and the line was resleepered in 1910, since which date individual sleepers had been replaced as necessary.

When Colonel Trench inspected the line subsequent to the accident he noted that generally speaking the condition of the sleepers was not unsatisfactory for a line of this category. As regards gauge, detailed measurements taken on the whole length from Hazelwood station to the derailment, on the day following the accident, indicated that gauge averaged about $\frac{1}{16}$th tight, with little variation ; on the day of the inquiry, examining the portion of the line including the curve beyond the derailment, which portion had, of course, no bearing on this actual derailment, he found considerable variation, up to $\frac{1}{2}$ in. slack, and in one rail length a variation from $\frac{3}{16}$th tight to $\frac{3}{4}$ in. slack. As regards level, the measurements taken on the tangent track over the distance from Hazelwood station to the derailment showed variations of either rail averaging $\frac{3}{16}$th, with a maximum in a few cases of about $\frac{1}{2}$ in. ; beyond the point of derailment the variations of level were generally of the same order. A great many joints were low and an appreciable proportion of the rails appeared to be permanently " hogged." When an engine of the same class passed along the track at a comparatively low speed, not exceeding 20 m.p.h., it was evident that there was considerable vertical movement of the track, more especially at the rail joints, and the wave effect was pronounced.

In giving evidence, the fireman said he thought the speed was 35-40 m.p.h. through Hazelwood and beyond to the point of derailment, but, on the whole, Colonel Trench is inclined to think that the train was travelling nearer 50 m.p.h. than 40 m.p.h. at the time and that this was an important factor contributory to the derailment. There was no speed restriction on the line, and he does not think that any blame should be attributed to the late Driver Gould, who was described as a careful and experienced driver, familiar with the line, and having a good record.

The condition of the permanent way was not, however, in his opinion, satisfactory even for a road officially classified as third class ; moreover, many of the defects were not such as would have necessitated a large amount of labour to rectify, such as would be entailed by resleepering, but were very largely such matters as loose and low joints, loose and defective keys, and loose spikes and defective trenails, a great proportion of which should have been dealt with by the patrol ganger. He can see no justification for the existence of many defects of this nature, and considers that the permanent way staff must be held responsible in no small degree for this derailment. At the same time it is only fair to mention that the existence of such short rail lengths (21 ft.) had no doubt a considerable bearing on the maintenance problem. He formed the impression that many of these rails had become permanently " hogged " or " cripped " so rendering the maintenance of a proper level at the joints a very difficult task. Apart from the defective condition of the permanent way, Col. Trench considers that the district permanent way inspector should have reported his opinion that trains were habitually running over this branch at speeds higher than he thought desirable. It was suggested that the permanent way gang had been reduced in numbers until it was difficult to provide adequate maintenance. The number is actually one in excess of the number as calculated by the company's normal formula, but apart from this, the nature of the defects was not considered by Col. Trench such as could fairly be attributed to any inadequacy of personnel.

Col. Trench concludes his report thus : The existence of rails of length as short as 21 ft. must add greatly to the difficulty of maintenance of a track which has to carry heavy locomotives. I consider, therefore, that a line of this description should be protected by a suitable speed restriction. I understand that the company has already issued instructions on this point. I am informed also that these short rails will be replaced next year.

In the course of my inquiry I formed the impression that the district permanent way inspector did not appreciate fully the value of riding on the footplate as a means of checking the condition of the track. The ultimate test of the condition of any track must be the manner in which a locomotive travels over it, and it would appear therefore that regular trips on the footplate are a very valuable method of judging the condition of a track, as well as being by far the most economical in time. The instructions on engine riding issued to district engineers direct that chief inspectors should ride over the main lines of their district on express trains at least once a month and district inspectors should ride over the lines in their district once a fortnight or as necessary, the results being reported to and recorded by the district engineers. I suggest that the importance of such inspection should be impressed on district inspectors.

Parliamentary Notes

Railways in India

In the House of Lords in Committee on the Government of India Bill, on July 4, the Marquis of Zetland, Secretary of State for India, moved an addition to clause 182 of the Bill. This clause provides that the executive authority of the Federation in respect of railways is to be exercised by the Federal Railway Authority. The amendment proposed enables the Federal Railway Authority to continue to carry on matters ancillary to the running of the railways. For example, the noble Marquis said, the railways might run road services or enter into agreements with other organisations to run road services in connection with the railways. In some cases at the present time the railways worked collieries to supply them with fuel.

The amendment was agreed to.

London Transport (Agreement) Bill

In the House of Lords on July 8, Earl Stanhope, Under Secretary of State for Foreign Affairs, moved the second reading of the London Passenger Transport Board (Agreement) Bill. [The objects of the Bill were recently fully explained in these pages when the Bill was before the House of Commons.] The noble Lord now briefly recapitulated the main objects of the Bill and of the agreement between the Transport Board, the Government, and the L.N.E.R. and G.W.R. There was no discussion and the second reading of the Bill was thereupon agreed to. On subsequent days the Bill passed through its remaining stages.

QUESTIONS IN PARLIAMENT

London Passenger Transport Board Employees

Mr. West asked the Minister of Transport on June 19 how many persons were employed by the London Passenger Transport Board on its formation ; and how many were now employed.

Mr. Hore-Belisha.—I am informed by the London Passenger Transport Board that, exclusive of railwaymen employed on joint lines, the total number of staff employed when it began operations was 70,500 and that at May 18, 1935, the total was 76,802. A number of additional undertakings had been transferred to the Board since it first began operations.

Abolition of Level Crossings

Brigadier-General Nation asked the Minister of Transport if he proposed to ask local authorities to submit schemes for the abolition of level crossings ; and, if so, whether any financial grants would be made towards the cost of the work.

Mr. Hore-Belisha.—Yes. I have reminded highway authorities that I am prepared to entertain applications for grants up to 75 per cent. of the net cost falling upon them of constructing bridges in lieu of level crossings.

Reconstruction of Bridges

Mr. Herbert Williams asked the Minister of Transport what progress was being made on the reconstruction of weak bridges.

Mr. Hore Belisha.—During the last two financial years schemes for the reconstruction of 129 bridges in private ownship were approved for grant. During the current financial year I have already been advised of schemes for the reconstruction of 242 other bridges which are to be put in hand during the current financial year.

Railway Expenses of State Servants

Rear-Admiral Sir Murray Sueter on June 26 asked the Chancellor of the Exchequer with the view of having the regulations as was always the case prior to 1931, whether he would reconsider the regulations regarding travelling expenses so as to grant first class warrants to officers and civil servants travelling on duty.

Commander Marsden asked the First Lord of the Admiralty whether it was intended to rescind the Admiralty order of 1933 under which officers below the rank of commander, when travelling on duty, were required to travel third class.

Mr. Duff Cooper (Financial Secretary to the Treasury), replying to both questions.—It will be recalled that in 1933 the question of the extent to which first class travel at the public expense should be allowed to officers of the defence services and civil servants was under consideration, and that, as from May 1, 1933, first class travel was normally restricted.—(1) In the case of the civil service to officials in receipt of £1,000 per annum and above (for women £850). (2) In the case of the Navy, Army and Air Forces, to officers of the rank of commander, lieutenant-colonel, and wing commander, or above, officers below these ranks when necessarily travelling in uniform being allowed the same privilege. The system has been reviewed in the light of its actual working, and it has been decided that modifications may now properly be made. Accordingly, the general arrangements for first class travel will in future include —(1) For the civil service, officials in receipt of £750 per annum and above (£600 for women). (2) For the defence services, officers of the rank of lieutenant-commander, major, and squadron leader, and above.

An Edmonton Level Crossing

Mr. John Rutherford asked the Minister of Transport whether he had any plans for the removal of the L.N.E.R. low-level line which, by the frequent closing of the level crossings, cut off the shopping centre of Edmonton Green from the main road, the tramcar and omnibus terminus, and the new Crown post office.

Mr. Hore-Belisha.—The company informs me that in view of the importance of the loop of which the line referred to forms part it has not considered the question of its removal.

Electrification in South Lancashire

Mr. Chorlton asked the Minister of Transport whether he would convey to the railway companies concerned in South Lancashire his willingness to consider a combined scheme of electrification.

Mr. Hore-Belisha replied that the Government had already indicated willingness to consider any useful schemes; the initiative must rest with the undertakings concerned. Regarding the particular area referred to, he had already been in communication with the railway companies and understood that a joint examination of electrification possibilities was being made by them.

The New L.P.T.B. South Harrow Station

We reproduce above two views of the new South Harrow station, London Passenger Transport Board, which was opened on Friday last, July 5. The upper view shows the west side entrance and station buildings; similar buildings are on the east side, where the corner site was formerly occupied by a small L.G.O.C. bus garage. The lower view is of the new platforms. Prior to the formation of the L.P.T.B., South Harrow was the last station on this line of the District Railway, and Metropolitan Railway property (thence to Uxbridge) began just beyond the platforms.

This station is the last but one (Park Royal) of the important stations on the line to be reconstructed under a scheme rendered necessary by the large and increasing traffic which has resulted from the projection of through Piccadilly Line tube trains to South Harrow on July 4, 1932, and (following the formation of London Transport) to Uxbridge on October 23, 1933.

XUM

NOTES AND NEWS

Institute of Transport Congress, 1936.—At the invitation of the Birmingham and District Section it has been decided to hold the next congress of the Institute of Transport at Birmingham from May 20–23, 1936.

L.M.S.R. Station Renamed.—Upper Birstall station on the L.M.S.R. Huddersfield-Leeds line will in future be known as Birstall Town, and Wootton Pillinge halt, on the Bletchley-Bedford line, as Stewartby.

Passimeter Booking Office for Harrogate.—The L.N.E.R. proposes to provide a passimeter type booking office on the up platform at Harrogate station. With the completion of the new booking office, enquiry office, and lounge waiting room on the Down side, and the introduction of one of the latest ticket issue and collection offices on the up side, Harrogate will rank as one of the most modern of the company's stations in the North Eastern Area.

Road Accidents.—The Ministry of Transport return for the week ended July 6, 1935, of persons killed or injured in road accidents is as follows. The figures in brackets are those for the corresponding period of last year:—

	Killed, including deaths resulting from previous accidents	Injured
England ...	... 103 (148)	4,420 (4,986)
Wales ...	... 5 (10)	193 (258)
Scotland ...	... 13 (22)	496 (529)
	121 (180)	5,109 (5,773)

The total fatalities for the previous week were 113, as compared with 139 for the corresponding period of last year.

A recent Southern Railway poster by Pat Keely, making clever use of the Belisha road crossing beacons to indicate the "best crossings" to the Continent

Fare Concessions in Czechoslovakia.—Fares on the Czechoslovak State Railways have been reduced by 66⅔ per cent. for travellers who intend to stay at least six days in one of the Czechoslovak spas.

Royal Assent to Railway, &c., Bills.—The Royal Assent was given on July 10 to the following among other Acts of 1935:—London Passenger Transport (Agreement); London Midland & Scottish Railway Order Confirmation; London & North Eastern Railway; Southern Railway.

Re-opening of West Auckland Engine Shed.—In consequence of the re-organisation of passenger train services on the Darlington and Blackhill branch and the Wear Valley branch of the L.N.E.R., it is proposed to re-open the West Auckland engine shed which has been closed for some years, and to transfer to that shed the engines and steam railcars now stabled at Shildon and Wear Valley Junction sheds.

Wear Valley Junction Station to be Closed.—Concurrently with the re-organisation of the L.N.E.R. train services, to which reference is made in the previous paragraph, the Wear Valley Junction station will be closed and the passenger business in the district will be dealt with at Etherley, Beechburn, or Witton-le-Wear stations, all of which are situated approximately one mile from Wear Valley Junction.

L.M.S.R. Ambulance Workers Honoured.—Six L.M.S. railwaymen have been admitted Serving Brothers of the Order of St. John, in recognition of their services to the L.M.S.R. ambulance movement, and will be invested with the insignia of the Order at St. John's Gate, London, on July 19. They are Messrs. A. Wells (signalman, Plodder Lane, Lancs.), A. Fairbrother (passenger guard, Hellifield, Yorks.), W. Boswell (traffic department, Chapel-en-le-Frith, Derbyshire), A. Buttrick (leading shipwright, Goole), G. E. Farmer (sub-ganger, Rugby), and J. H. Green (ganger, Castlethorpe, Bucks.).

The King's Langley Accident.—The report by Colonel Mount on the three collisions of March 13 at King's Langley, L.M.S.R., has now been published and we shall review it in an early issue. The only person considered to blame is Signalman Gibbs, of King's Langley, who, when the up meat train was an unusually long time in the section, assumed that it must have passed, gave train-out-of-section for it to Nash Mills signal box, and accepted the milk train. As a result of the consequent collision, the adjoining down slow line was fouled, the down freight train on that line ran into the obstruction, and into this confused mass the coal train on the up slow line forced its way. The weight of the four trains concerned totalled 2,730 tons.

London Transport Bills.—The London Transport Board (Finance) Bill was considered on July 10 by the House of Commons Committee on Unopposed Bills and was reported for third reading. The object of the Bill is to obtain the necessary powers to implement the agreement with the Treasury embodied in the London Passenger Transport (Agreement) Bill. A Select Committee of the House of Lords began to consider on July 9 the London Passenger Transport Bill, which had already been passed by the House of Commons. The main opposition was from the Abbey Road Building Society, in connection with the proposed new tube between Baker Street and Finchley Road. The Society asked for an extension to seven years of the right to claim compensation for possible damage to its buildings, which might result from the working of the railway.

Railcar in Collision in U.S.S.R.—In a collision reported from Moscow yesterday, between a goods train and a railcar near Omsk, Siberia, six persons were burnt to death. Presumably, it was a petrol-engined car.

A Swedish Accident.—Seven persons were killed and 15 injured when a ballast train carrying a party of workmen crashed into two horses which had strayed on the line near Lulea on June 27. It is reported that the locomotive was at the rear of the train, and that owing to a curve the driver did not see the horses until it was too late to pull up and avert the crash.

Regimental Plaques for L.M.S.R. Locomotive.—The L.M.S.R. "Royal Scot" class locomotive *West Yorkshire Regiment* was presented on June 24 at Wellington station, Leeds, with two plaques carrying the regimental crest. The ceremony was performed by the Colonel of the regiment, General Sir C. J. Deverell, K.C.B., in the presence of past and serving members from York, Bradford, and other West Yorkshire towns.

Lübeck-Büchener Railway Results.—According to the annual report of the Lübeck-Büchener Eisenbahngesellschaft for the year 1934, it is proposed to increase the renewals fund from 2,439,312 marks to 4,139,312 marks to provide for renewals to be effected in the near future. The allocation of 1,700,000 RM. for this purpose is made up of 700,000 RM. transferred from reserve and 1,000,000 R.M. taken from the operating surplus of 601,067 R.M. and the amount of 445,047 R.M. brought forward from 1933, leaving 46,115 R.M. to be carried forward to the new account.

Soviet Orders for Great Britain.—The orders placed in Great Britain by Soviet trading organisations in May amounted to £589,214, as compared with £748,693 in the corresponding month in 1934. In the first five months of this year the purchases totalled £3,917,460, compared with

£4,198,028 in the corresponding period of the preceding year; there was thus a decrease by nearly 7 per cent. The following table shows the principal orders for engineering and allied equipment and materials placed during the period under consideration :—

	May, 1935 £	May, 1934 £	Jan.-May, 1935 £	Jan.-May, 1934 £
Machinery and equipment ..	84,543	114,170	927,958	458,337
Steel and ferrous alloys	49,545	88,328	393,019	791,003
Non-ferrous metals ..	167,336	76,863	886,567	1,122,589

The orders for machinery and equipment have shown an increase this year, but those for steel and non-ferrous metals have gone down considerably.

American Rolling Stock Orders.—The Chesapeake & Ohio Railway has now placed orders for 5,125 freight cars with various American manufacturing companies, says Reuters Trade Service from New York. The order comprises 5,000 50-ton hopper coal cars, to cost $1,500,000, 50 single-deck 40-ton stock cars, to cost $130,000, and 75 steel under-frame 50-ton flat cars, to cost $189,000. This is the largest order for railway equipment placed for many months and will require some 65,000 tons of steel, thus bringing a substantial amount of business to the U.S.A. steel mills. The Chesapeake & Ohio Railway, in issuing inquiries for this order a few weeks ago, also asked for tenders for five high-speed locomotives, but, so far as can be learned, no awards for the construction of these locomotives have yet been made.

A Railway "Ancient Monument."—Causey Arch, near Stanley, in County Durham, has been scheduled as an ancient monument by H.M. Office of Works. This structure, which is probably the oldest railway bridge in the world, was built in 1727 to carry a wooden wagon way across Houghwell Burn. The wagon way, of course worked by horses, was part of a system of lines constructed by the important group of mine owners known as the "Grand Allies." The arch now "scheduled" has a span of 105 ft.

British and Irish Traffic Returns

GREAT BRITAIN	Totals for 27th Week			Totals to Date		
	1935	1934	Inc. or Dec.	1935	1934	Inc. or Dec.
	£	£	£	£	£	£
L.M.S.R. (6,925¼ mls.)						
Passenger-train traffic...	571,000	563,000	+ 8,000	11,960,000	11,675,000	+ 285,000
Merchandise, &c. ...	449,000	431,000	+ 18,000	12,042,000	12,014,000	+ 28,000
Coal and coke ...	197,000	194,000	+ 3,000	6,322,000	6,307,000	+ 15,000
Goods-train traffic ...	646,000	625,000	+ 21,000	18,364,000	18,321,000	+ 43,000
Total recipts	1,217,000	1,188,000	+ 29,000	30,324,000	29,996,000	+ 328,000
L.N.E.R. (6,336 mls.)						
Passenger-train traffic	380,000	370,000	+ 10,000	7,761,000	7,555,000	+ 206,000
Merchandise, &c. ...	283,000	272,000	+ 11,000	8,289,000	8,358,000	− 69,000
Coal and coke ...	194,000	192,000	+ 2,000	6,058,000	6,198,000	− 140,000
Goods-train traffic ...	477,000	464,000	+ 13,000	14,347,000	14,556,000	− 209,000
Total receipts	857,000	834,000	+ 23,000	22,108,000	22,111,000	− 3,000
G.W.R. (3,749¼ mls.)						
Passenger-train traffic...	246,000	251,000	− 5,000	4,940,000	4,871,000	+ 69,000
Merchandise, &c. ...	192,000	176,000	+ 16,000	4,862,000	4,816,000	+ 46,000
Coal and coke ...	90,000	84,000	+ 6,000	2,674,000	2,694,000	− 20,000
Goods-train traffic ...	282,000	260,000	+ 22,000	7,536,000	7,510,000	+ 26,000
Total receipts	528,000	511,000	+ 17,000	12,476,000	12,381,000	+ 95,000
S.R. (2,171 mls.)						
Passenger-train traffic...	352,000	345,000	+ 7,000	7,411,000	7,259,000	+ 152,000
Merchandise, &c. ...	55,500	55,000	+ 500	1,620,500	1,722,000	− 101,500
Coal and coke ...	18,500	21,000	− 2,500	813,500	851,000	− 37,500
Goods-train traffic ...	74,000	76,000	− 2,000	2,434,000	2,573,000	− 139,000
Total receipts	426,000	421,000	+ 5,000	9,845,000	9,832,000	+ 13,000
Liverpool Overhead ... (6½ mls.)	1,408	1,243	+ 165	31,018	30,047	+ 971
Mersey (4½ mls.) .	3,895	4,172	− 277	108,805	111,725	− 2,920
*London Passenger Transport Board ...	566,000	557,600	+ 8,400	566,000	557,600	+ 8,400
IRELAND						
Belfast & C.D. pass. (80 mls.)	3,976	4,214	− 238	58,232	57,785	+ 447
,, ,, goods	507	409	+ 98	13,472	14,266	− 794
,, ,, total	4,483	4,623	− 140	71,704	72,051	− 347
Great Northern pass. (543 mls.)	15,300	14,950	+ 350	250,250	231,950	+ 18,300
,, ,, goods	9,250	8,400	+ 850	245,500	235,150	+ 10,350
,, ,, total	24,550	23,350	+ 1,200	495,750	467,100	+ 28,650
Great Southern pass. (2,124 mls.)	33,459	32,983	+ 476	691,792	584,284	+ 7,508
,, ,, goods	31,974	31,395	+ 579	824,828	767,087	+ 57,741
,, ,, total	65,433	64,378	+ 1,055	1,516,620	1,451,371	+ 65,249

* 1st week, the receipts for which include those undertakings not absorbed by the L.P.T.B. in the corresponding period last year; last year's figures are, however, adjusted for comparative purposes

British and Irish Railways Stocks and Shares

Stocks	Highest 1934	Lowest 1934	Prices July 10, 1935	Prices Rise/Fall
G.W.R.				
Cons. Ord. ...	66⅛	48½	51	+1
5% Con. Prefce. ...	118	109	122½	+1½
5% Red. Pref. (1950)	115	107	113⅛	+1
4% Deb.	117	105	115½	—
4½% Deb.... ...	119	109	115⅛	—
4½% Deb.... ...	129⅛	115¼	127⅛	—
5% Deb.	135	126¼	138⅛	+2
2½% Deb.... ...	75	64	78	—
5% Rt. Charge ...	134⅞	123¼	135⅛	+1
5% Cons. Guar. ...	132⅝	121¾	135½	+1
L.M.S.R.				
Ord.	30½	19⅛	21½	+½
4% Prefce. (1923)	64¼	41	57	+½
4% Prefce. ...	87	69½	83½	+1
5% Red. Pref. (1955)	107	92½	103½	—
4% Deb.	114⅛	100⅛	107	—
5% Red. Deb. (1952)	118⅛	111¼	115½	—
4% Guar.... ...	106½	96⅝	103	+½
L.N.E.R.				
5% Pref. Ord. ...	24⅝	13½	12¼	+¼
Def. Ord.	11½	6⅞	6⅛	+⅛
4% First Prefce. ...	76	59½	65½	+½
4% Second Prefce.	47	25½	25½	+½
5% Red. Pref. (1955)	94½	80	84⅛	+2
4% First Guar. ...	104	92	101	+½
4% Second Guar.	97⅞	86½	94	+½
3% Deb.	90	74½	81	—
4% Deb.	114	99¼	106	—
5% Red. Deb. (1947)	117	108	113½	—
4½% Sinking Fund Red. Deb.	111¼	105¼	110	+1
SOUTHERN				
Pref. Ord.... ...	90	63⅛	84	—
Def. Ord.	32⅝	19	23	—
5% Prefce. ...	118 5/16	107½	122	+½
5% Red. Pref. (1964)	115¾	107½	116⅛	—
5% Guar. Prefce.	132	120⅝	135½	+2
5% Red. Guar. Pref. (1957)	119½	113	119½	—
4% Deb.	116½	103¼	114	+½
5% Deb.	134	124 13/16	135½	+2
4% Red. Deb. 1962–67	113 11/16	105 9/16	113½	—
BELFAST & C.D.				
Ord.	6	5	4	—
FORTH BRIDGE				
4% Deb.	110	100	108½	—
4% Guar.	110	100	107½	—
G. NORTHERN (IRELAND)				
Ord.	9⅝	4 15/16	9	—
G. SOUTHERN (IRELAND)				
Ord.	25	12½	30	—
Prefce.	21½	13 15/16	38⅝	—
Guar.	48	39	70¼	—
Deb.	67	59	79½	+½
L.P.T.B.				
4½% "A" ...	126	115	124⅛	—
5% "A"	135½	124½	134½	—
4½% "T.F.A." ...	113½	107½	111	—
5% "B"	131⅝	118	127⅛	—
"C"	97	73	99	—
MERSEY				
Ord.	15¼	7	12	—
4% Perp. Deb. ...	93½	82½	94½*	−1
3% Perp. Deb. ...	66½	61½	68½*	−1
3% Perp. Prefce....	54	44½	52½	—

* ex-dividend

CONTRACTS AND TENDERS

Locomotives Ordered for India

Robt. Stephenson & Co. Ltd. has received an order from the South Indian Railway, to the inspection of Messrs. Robt. White & Partners, for seven PT class 2-6-4 superheated tank locomotives for service on the broad gauge. These engines will have the Associated Locomotive Equipment Company's R.C. poppet valve gear, A.B.C. Coupler Company's Joco regulator valve, and J. Stone & Co.'s electric headlight equipment. Their maximum axle load is 16 tons.

Fried. Krupp A.G. has received an order from the Indian State Railways Administration for 29 broad gauge 0-4-2 tank locomotives to be supplied to the inspection of Messrs. Rendel, Palmer & Tritton. Of these, 15 of the XT class are required for the North Western Railway and 14 of the slightly modified XTI class with different tank capacity are for the East Indian Railway. Timken roller bearings will be fitted to the trailing boxes of both classes. Caprotti valve gear will be fitted to both batches. The XT class for light load working was illustrated and described in our issue of July 1, 1932.

Nasmyth Wilson & Co. Ltd. has received an order from the Bengal-Nagpur Railway for eight superheated boilers for K class locomotives.

The Bombay, Baroda & Central India Railway Administration has placed orders for seven copper fireboxes with Linley & Co. Ltd. and 17 copper fireboxes with Deutsche Metallwerke A.G., to the inspection of Messrs. Rendel, Palmer & Tritton.

The Clyde Engineering Co. Ltd. has received orders from the New South Wales Government Railway Department for the construction of ten first-class and five second-class coaches at £3,530 each, and 50 manual Sheffield trolleys and 99 trailers.

J. Baker & Bessemer Limited has received an order for 40 pairs of wheels and axles required for the ten bogie tank and general purpose wagons which, as recorded in this column in our June 21 issue, are being supplied, through Nye & Menzies Limited, by La Brugeoise et Nicaise et Delcuve for the Peruvian Corporation.

The Yorkshire Hennebique Contracting Co. Ltd. has received from the L.N.E.R. a contract valued at £29,000 for the reconstruction of the New Holland pier head in connection with the improved ferry-service between Hull and New Holland.

The Egyptian State Railways Administration has placed orders for signalling materials with the Westinghouse Brake & Saxby Signal Co. Ltd.; and Rylands Bros. Ltd.; and Stewarts and Lloyds Limited has received orders for cadmium wire and bronze phosphor wire.

British (Guest Keen Baldwins) Iron & Steel Co. Ltd. has received an order for 4,150 metric tons of flat-bottomed rails or the Egyptian State Railways.

The Steel Company of Scotland has received an order for 400 carriage and wagon tyres for the Assam-Bengal Railway.

The Superheater Co. Ltd. has received an order from the South Indian Railway, to the inspection of Messrs. Robt. White & Partners, for superheater elements for metre-gauge locomotives.

Brazilian Locomotive Orders for Germany

The Ceara Railway of Brazil has given an order to a German firm for the early delivery of five freight engines, says Reuters Trade Service, quoting the *Deutsche Bergwerks Zeitung*.

The South African Railways & Harbours Administration has placed the following orders :—

Stahl Union Export Co. Ltd.: Check rail chairs (B6987/1, £774).

S.A. des Usines et Acieries Allard: Cast steel buttresses (B6987/2, £602 5s!).

Boulonneries de Mariemont: Bolts and nuts (B6681/6, £1,100), also S. A. Gilsoco (£1,100); Chas. Richards & Sons Ltd. (£3,147 6s. 3d.); Guest, Keen & Nettlefolds (£3,147 6s. 3d.) and Usines et Acieries Allard (£945 10s.).

Tees Side Bridge & Engineering Co. Ltd.: Gauge clips (B6681/5, £9,566 13s. 3d.); also Anderston Foundry Limited (£3,492 6s. 3d.).

British Lock Washers Limited: Spring washers (B6681/7, £1,832 14s.).

S. A. Acieries & Ferriere Lombard Falch: Bolts and nuts (B6681/6, £900); also Laminoirs et Boulonneries de Ruan (£1,083 6s. 8d.), and Chas. Richards & Sons Ltd. (£5,284 6s. 8d.).

New Equipment for Canadian National Railways

The Canadian National Railways Administration has invited tenders for 250 refrigerator cars, 300 general service freight cars, 150 sand cars, 400 automobile cars, and both freight and passenger locomotives. This constitutes a part of the construction programme which has been laid down for the National system, the financing of which was provided for in the Unemployment Relief Act recently passed by the Canadian Parliament. In addition, 250 refrigerator cars will be constructed in the company's shops and the programme also provides for a considerable amount of repair work to be done in the main shops of the system. This latter will result in an additional two days' work per man in each of the main shops.

Holden & Brooke Limited has received an order for two centrifugal pumps for the Bengal-Nagpur Railway.

Linley & Co. Ltd. has received an order, to the inspection of Messrs. Robt. White & Partners, for 24 flanged copper firebox plates for locomotives for the South Indian Railway.

British Timken Limited has received an order for 54 axle boxes from the Mersey Railway. They are for six new third-class electric trailer cars. The coaches are required to increase the size of trains on the Mersey Railway from 5 to 6 cars each. An order has also been received for bearings for the tenders of 3 "YK" class 4-6-2 locomotives now being built by the Hunslet Engine Co. Ltd., Leeds, for the Assam Bengal Railway. The Hobart tramways have placed an order for a set of tapered roller bearing axleboxes for fitting to one eight-wheeled tramcar. This is a conversion from the ordinary type of bearing and the tramcar has been so equipped as an experiment. It is understood to be the first time that anti-friction bearings have been fitted to tramcars in Tasmania. An order has also been received for bogie centre pivot bearings for fitting to 14 electric trailer cars now being built for the London Passenger Transport Board, by the Birmingham Railway Carriage & Wagon Co. Ltd., Smethwick.

Burn & Co. Ltd. has received orders from the Indian Stores Department for 400,000 m.s. jaws for c.i. sleepers at a total price of Rs. 54,167.

The Bikaner State Railway Administration has ordered 20 12-ft. switches from R. White & Sons and cast-steel crossings from Edgar Allen & Co. Ltd., all to the inspection of Messrs. Rendel, Palmer & Tritton.

The L.N.E.R. has recently ordered two and a quarter million gallons of creosote oil, 2,500 tons of pig iron, 4,780 gross of fog signals, 27,000 yds. of cloth, 1,500 yds. of navy tweed, 300,000 yds. of "blue jean" and 128,250 yds. of serge.

Enquiry for Steam Travelling Break-down Crane

The South African Railways & Harbours Administration is calling for tenders, to be presented in Johannesburg by August 19, for the supply of a 36-ton steam travelling break-down crane. Further details of this call for tenders can be obtained from the Department of Overseas Trade, London, S.W.1. Reference number T.Y. 5018 should be quoted.

Locomotives, Steam or Diesel Required

The Sorocabana Railway, it is reported, is inviting tenders receivable at 1st Division Head Office, Stores Department, Sorocabana Railway, San Paulo, by August 6, for nine metre-gauge steam locomotives of the 0-8-0 type for shunting purposes. Six of these engines are to have a maximum axle-load of 14 tons and a tractive effort of 12,500 kg., the corresponding specifications for the remaining three engines being 12 tons and 10,000 kg. respectively. Alternatively, diesel-mechanical or diesel-electric locomotives of the same axle loading and tractive effort may be offered by the tendering firms.

Tenders are invited by the Sudan Government Railways, receivable by August 7, by the Purchasing Agent, Wellington House, Buckingham Gate, Westminster, S.W.1, for the supply of 70,000 tons of colliery screened coal of Welsh, Newcastle, Durham or South African varieties for delivery c.i.f. Port Sudan over period from latter part of October, 1935, to end of May, 1936.

OFFICIAL NOTICES

Bombay, Baroda & Central India Railway Company

NOTICE IS HEREBY GIVEN that the One Hundred and Forty-Eighth General Meeting of the Bombay, Baroda & Central India Railway Company will be held at Southern House, E.C. (formerly Cannon Street Hotel), on Wednesday, the 24th July, at 1 o'clock precisely.

(1) To receive the Directors' report and accounts.
(2) To declare a dividend.
(3) To transact the general business of the Company.

Warrants for the guaranteed interest and dividend will be forwarded on the 24th day of July to Stockholders registered in the Company's books on the 29th day of June, 1935.

By Order,
S. G. S. YOUNG,
Secretary.

N.B.—A copy of the Directors' report and accounts can be obtained by any Stockholder on application to the Secretary.

Offices: The White Mansion,
91, Petty France,
Westminster, S.W.1.
8th July, 1935.

PATENTS for Inventions, Trade Marks, Advice, Handbook, and consultations free. King's Patent Agency, Ltd. (B. T. King, C.I.M.E., Registered Patent Agent, G.B., U.S., and Canada), 146A, Queen Victoria Street, London, E.C.4. 49 years' references. 'Phone City 6161.

South Indian Railway Company Limited

THE Directors are prepared to receive Tenders for the supply of:—

ANTI-CORROSIVE PAINT.

Specifications and Forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W.1.

Tenders addressed to the Chairman and Directors of the South Indian Railway Co. Ltd., marked "Tender for Anti-corrosive Paint," with the name of the firm tendering, must be left with the undersigned not later than 12 noon on Friday, the 19th July, 1935.

The Directors do not bind themselves to accept the lowest or any tender.

A charge, which will not be returned, will be made of 5s. for each copy of the Specification.

E. A. S. BELL,
Acting Managing Director.

91, Petty France,
Westminster, S.W.1.
11th July, 1935.

THE MADRAS & SOUTHERN MAHRATTA RAILWAY COMPANY LIMITED invite Tenders for:—

3,000 STEEL BOILER TUBES (SOLID DRAWN).

Specification and Form of Tender can be obtained at the Company's Offices, 25, Buckingham Palace Road, Westminster, S.W.1.

Fee ONE GUINEA, *which will not be returned.*

Tenders must be submitted not later than 2 o'clock p.m. on TUESDAY, 23RD JULY, 1935.

The Directors do not bind themselves to accept the lowest or any Tender and reserve to themselves the right of reducing or dividing the order.

By Order of the Board,
G. W. V. DE RHE PHILIPE,
Secretary.

THE ASSAM-BENGAL RAILWAY COMPANY, LIMITED, is prepared to receive tenders for:—

100 PAIRS WHEELS AND AXLES FOR WAGONS.

Specifications and tender forms may be obtained at the Offices of the Company, 56, Victoria Street, S.W.1. A fee of £1 1s. is charged for each specification, which cannot be returned.

Drawings may be had at the cost of the tenderer by application to Messrs. Hodges, Bennett & Co. Ltd., 78, Queen Victoria Street, E.C.4.

Tenders must be delivered at the Company's Offices not later than noon on Friday, the 19th July, 1935.

The Directors do not bind themselves to accept the lowest or any tender.

By order of the Board,
W. H. J. GORE,
Secretary.

19th July, 1935.

OFFICIAL ADVERTISEMENTS intended for insertion on this page should be sent in as early in the week as possible. The latest time for receiving official advertisements for this page for the current week's issue is noon on Thursday. All advertisements should be addressed to:—*The Railway Gazette*, 33, Tothill Street, Westminster, London, S.W.1.

RAILWAY AND OTHER REPORTS

Assam Railways & Trading Co. Ltd.—The directors have declared the half-yearly dividends on the pre-preference "A" shares and the new 6 per cent. preference shares.

Midland Bank Limited.—The directors announce an interim dividend for the half-year ended June 30 last at the rate of 16 per cent. per annum less income tax, payable on July 15 next. The same rate of dividend was declared a year ago.

Egyptian Delta Light Railways.—A dividend of 1 per cent. for the year ended March 31, 1935, will be paid on the preference shares on July 20, 1935, subject to confirmation at the annual general meeting. Last year a similar payment was made.

Leopoldina Terminal Co., Ltd., The net revenue for 1934 amounted to £14,364 (against £6,164 for 1933). To this has been added £54,386 (against £62,586) due from the Leopoldina Railway Company under guarantee, making £68,750, which is absorbed by interest on the first debentures and sinking fund charges. The 5 per cent. debenture holders agreed on May 29 to suspension of the sinking fund for two years.

Western Welsh Omnibus Co. Ltd.—This company, which is controlled jointly by the Great Western Railway Company and the British Electric Traction Co. Ltd., obtained for the year ended March 31, 1935, a net profit of £26,958 (against £13,425 for the previous year), which, added to the balance of £4,069 brought forward, makes a total of £31,027 out of which the directors have written off the balance of the preliminary expenses, amounting to £1,500. The dividend of 7½ per cent. takes £21,750, leaving £7,777 to be carried to undivided profits account. For the previous year the dividend was 5 per cent. The liquidation of the subsidiary companies—Lewis & James Limited and Eastern Valley Motor Services (Barretts) Limited—has now been completed. During the year the business of Thomas Bros., Llanstephen, was acquired.

Ribble Motor Services Limited.—For the year ended March 31, 1935, this company, which is controlled jointly by the London Midland & Scottish Railway Company and Tilling & British Automobile Traction Limited, secured a total revenue of £1,234,986, against £1,213,810 for the previous year. After deducting all expenses, including £174,000 charged to depreciation reserve there remains a balance of £121,922, which, added to £45,317 brought forward, leaves an available balance of £167,239. From this balance £30,000 is allocated to general reserve, £10,000 to employees' assistance fund, and £13,000 to the preference dividend. The dividend of 10 per cent. for the year (the same as for 1933-34) takes £60,000, leaving £54,239 to be carried forward. An order has been placed for additional motor coaches of the latest type. The investments in London Coastal Coaches Limited and W. C. Standerwick Limited have been increased and an investment has been made in Blackpool Omnibus Stations Limited. The road passenger businesses of W. & G. Coachways (Manchester) Limited, Kenyons, Coleman & Robinson Limited, and M. & N. Motors Limited have been purchased.

Callender's Cable & Construction Co. Ltd.—The accounts for the year 1934 show a net profit of £236,729, which is nearly £11,000 higher than for 1933. There has been an increase in the volume of trade in most sections of the company's operations, but owing to keen competition, the rate of profit has been affected. The company's business in India continues on a large scale, while the South African and Australian trade is improving. For the sixteenth year the dividend on the ordinary shares is 15 per cent. The balance forward is raised by £12,141 to £306,372.

General Electric Co. Ltd.—The directors announce that profits for the year ended March 31 amounted to £1,184,483, which compares with £971,481 for 1933-34. They propose to pay on July 20 a dividend of 10 per cent. for the year on the ordinary shares, against 8 per cent. for each of the three preceding years. All the company's works have been fully employed throughout the year. The heavy engineering works have benefited by the increased demand for industrial and mining plant, and there has been improved business in general electrical supplies. Export business shows a considerable increase on last year's figures. During the year redemption was effected of the still outstanding £3,482,500 debenture stock by an issue of ordinary shares at a premium. The sum of £98,883 has been allocated out of the year's profits to the reserve account, which has now reached the figure of £3,400,000.

XUM

Railway Share Market

The stock and share markets have been steady on the whole, but prices are feeling the customary influence of the desultory liquidation which invariably precedes the summer holiday period. It is a very common practice for investors of moderate means to select for sale shares which have fallen in price in order to realise funds for holidays, on the policy apparently that to "cut losses" and "run profits" is a sound market axiom.

It is, however, entirely opposed to the usual practice of the professional or large market operators. Nevertheless, it has to be reckoned with as a factor influencing prices at this season of the year, and it probably accounts for the absence of any decisive response in the Home Railway market to the favourable traffic returns of Wednesday. On the earlier days of the week the tone had been strong, with optimistic views centred on the coming interim statements. These favourable views are still held, but the offer of small lots of stock with an absence of new buyers discouraged the market dealers from accumulating stock on their books. The adverse movement in prices was not considered to be serious, and a recovery is anticipated if the interim statements to be issued on the 25th and 26th inst. are as favourable as currently expected. The outstanding feature of the week's business was the persistent buying of the London Midland & Scottish issues, especially 1923 preference stock, which rose to 57½ on Tuesday on prospects of a dividend for this year at the full rate. The ordinary stock is held by many market observers to be cheaper in comparison, as the 1923 preference stock would give a yield of only 7 per cent., whereas the ordinary stock on the basis of 2 per cent. paid for 1930 would give a yield of over 9 per cent., and on the basis of the 4½ per cent. paid for 1929 would return over 20 per cent. It is not suggested that a repetition of dividends on the ordinary stock on this scale is near at hand, but the underlying reasons for the rival support of the two stocks is interesting.

In foreign railways the most active stocks have been the Argentine railway issues on the prospect of the accounts for the past financial year tending to confirm recent statements that the peso exchange outlook is becoming more favourable and that funds are being obtained in larger amounts than for some time past. Brazilian issues were quiet, with Leopoldina steady on a favourable interpretation being placed on the report.

Traffic Table of Overseas and Foreign Railways Publishing Weekly Returns

	Railways	Miles open 1934-35	Week Ending	Traffics for Week: Total this year	Traffics for Week: Inc. or Dec. compared with 1934	No. of Weeks	Aggregate Traffics to Date: Totals: This Year	Aggregate Traffics to Date: Totals: Last Year	Aggregate Traffics to Date: Increase or Decrease	Shares or Stock	Prices: Highest 1934	Prices: Lowest 1934	Prices: July10, 1935	Yield % (See Note)
				£	£		£	£	£					
South & Central America.	Antofagasta (Chili) & Bolivia	830	7 7.35	12,580	— 1,210	27	333,980	352,070	— 18,090	Ord. Stk.	26 5/1	19	21	Nil
	Argentine North Eastern	753	6.7.35	7,813	+ 197	1	6,602	7,616	— 1,014	„	11	6 7/8	7	Nil
	Argentine Transandine	111	—	—	—	—	—	—	—	A. Deb.	52	45	46 1/2	8 5/8
	Bolivar	174	June, 1935	6,000	+ 900	26	39,400	38,750	+ 650	6 p.c. Deb.	10	6 1/2	10	Nil
	Brazil	—	—	—	—	—	—	—	—	Bonds.	13 3/4	10 7/16	13	31 5/16
	Buenos Ayres & Pacific	2,806	6.7.35	77,837	+ 7,636	1	69,841	70,201	— 360	Ord. Stk.	16 1/2	8 1/2	9 1/2	Nil
	Buenos Ayres Central	190	23.6.35	$128,900	+ $10,200	51	$5,659,600	$5,450,600	+ $209,000	Mt. Deb.	23	10	16	Nil
	Buenos Ayres Gt. Southern	5,085	6.7.35	117,284	— 4,154	1	106,937	121,438	— 14,501	Ord. Stk.	35	22	24	Nil
	Buenos Ayres Western	1,930	6.7.35	50,676	+ 4,727	1	37,507	45,949	— 8,442	„	27 1/2	18 1/2	19	Nil
	Central Argentine	3,700	6.7.35	129,914	+ 4,587	1	112,413	125,327	— 12,914	„	23	13 1/2	14	Nil
	Do.	—	—	—	—	—	—	—	—	Dfd.	14	7	8	Nil
	Cent. Uruguay of M. Video	273	6.7.35	10,263	— 7,988	1	8,049	18,251	— 10,202	Ord. Stk.	15 1/2	8	4 1/2	Nil
	Do. Eastern Extn.	311	6.7.35	1,614	+ 288	1	1,213	1,386	— 173	—	—	—	—	—
	Do. Northern Extn	185	6.7.35	1,157	+ 251	1	918	906	+ 12	—	—	—	—	—
	Do. Western Extn.	211	6.7.35	616	+ 110	1	420	506	— 86	—	—	—	—	—
	Cordoba Central	1,218	6.7.35	39,040	+ 2,940	1	33,630	36,100	— 2,470	Ord. Inc.	8	3	2 1/2	Nil
	Costa Rica	188	May, 1935	13,867	— 2,792	48	176,238	197,823	— 21,585	Stk.	30 3/4	23 1/2	32	6 1/4
	Dorada	70	May, 1935	10,900	+ 600	21	55,000	51,400	+ 3,600	1 Mt. Db.	103	95	102 1/2	5 7/8
	Entre Rios	810	6.7.35	12,052	+ 2,534	1	10,370	9,518	+ 852	Ord. Stk.	21 1/2	12	12 1/2	Nil
	Great Western of Brazil	1,082	6.7.35	5,000	— 1,600	27	216,900	215,800	+ 1,100	Ord. Sh.	7/8	3/8	1/2	Nil
	International of Cl. Amer.	794	May, 1935	$497,050	+ $21,927	21	$2,260,638	$2,466,672	— $206,034	—	—	—	—	—
	Interoceanic of Mexico	—	—	—	—	—	—	—	—	1st Pref.	1/-	1/-	1/2	Nil
	La Guaira & Caracas	22 3/4	June, 1935	3,915	+ 35	26	23,845	21,435	+ 2,410	Stk.	12 3/4	7 5/8	8 1/2	Nil
	Leopoldina	1,918	6.7.35	27,242	— 2,673	27	591,451	583,108	+ 8,343	Ord. Stk.	14 5/8	7	4 1/2	Nil
	Mexican	483	30.6.35	$317,400	— $11,400	26	$6,326,000	$5,994,800	+ $331,200	„	3 1/4	1 1/2	1	Nil
	Midland of Uruguay	319	June, 1935	5,800	— 2,399	52	109,846	111,908	— 2,062	„	1 1/2	1/2	1 1/2	Nil
	Nitrate	401	30.6.35	5,409	+ 545	26	72,513	76,698	— 4,185	Ord. Sh.	3 9/32	51/-	2 1/4	Nil
	Paraguay Central	274	6.7.35	$1,857,000	+ $921,000	1	$1,592,000	$936,000	+ $656,000	Pr. Li. Stk.	84	67	73 1/2 §	8 5/16
	Peruvian Corporation	1,059	June, 1935	66,756	+ 11,914	52	764,032	674,250	+ 89,782	Pref.	14 1/2	8	8 1/2	Nil
	Salvador	100	29.6.35	¢16,050	+ ¢7,937	52	¢1,062,132	¢1,051,508	+ ¢10,624	Pr. Li. Db.	75	70	65	7 11/16
	San Paulo	1531/2	30.6.35	29,371	+ 691	26	666,561	725,072	— 58,511	Ord. Stk.	86	67	51	4 7/8
	Taltal	164	June, 1935	2,875	+ 657	52	36,940	27,268	+ 9,672	Ord. Sh.	2 1/2	1 7/16	1 1/2	6 11/16
	United of Havana	1,365	6.7.35	17,816	+ 105	1	15,715	17,711	— 1,996	Ord. Stk.	6	2	2 1/2	Nil
	Uruguay Northern	73	June, 1935	608	— 370	52	11,946	13,533	— 1,587	Deb. Stk.	6 1/4	3	4 1/2	Nil
Canada.	Canadian National	23,735	30.6.35	850,345	— 46,151	26	16,028,664	15,899,349	+ 129,315	—	—	—	—	—
	Canadian Northern	—	—	—	—	—	—	—	— 4 p.c.	Perp. Dbs.	78 1/4	51 1/2	56 1/2	7 1/16
	Grand Trunk	—	—	—	—	—	—	—	—	4 p.c. Gar.	104 1/2	97 1/4	100 1/2	9 5/16
	Canadian Pacific	17,211	30.6.35	637,600	— 63,200	26	11,305,600	11,442,200	— 136,600	Ord. Stk.	18 5/16	11 1/16	10	Nil
India.†	Assam Bengal	1,329	20.6.35	35,685	— 1,952	11	262,485	322,804	— 60,319	Ord. Stk.	88 1/2	72	83 1/2	3 9/16
	Barsi Light	202	10.6.35	3,577	— 270	10	26,947	33,367	— 6,420	Ord. Sh.	104 1/2	98 3/4	30 1/2	6 1/16
	Bengal & North Western	2,114	20.6.35	71,547	— 5,548	11	619,073	656,847	— 37,774	Ord. Stk.	297 1/2	262	293 1/2	5 7/16
	Bengal Dooars & Extension	161	10.6.35	2,849	— 1,090	10	21,285	24,278	— 2,993	„	125 1/4	124	125 1/2	5 9/16
	Bengal-Nagpur	3,268	31.5.35	202,575	— 9,925	7	1,119,525	1,085,186	+ 34,338	„	105 1/2	96	102 1/2	3 7/8
	Bombay, Baroda & Cl. India	3,072	30.6.35	212,850	— 20,100	13	2,163,525	2,178,525	— 15,000	„	115	108 1/2	113 1/2	5 5/16
	Madras & South'n Mahratta	3,230	10.6.35	148,875	— 21,937	10	1,110,900	1,276,371	— 165,471	„	131	122 3/4	121 1/2	7 13/16
	Rohilkund & Kumaon	572	20.6.35	13,088	— 713	11	123,285	132,202	— 8,917	„	263	250	287 1/2	5 9/16
	South India	2,526	20.6.35	122,673	+ 4,923	11	930,559	963,218	— 32,659	„	119	115	117 1/2	6 13/16
Various.	Beira-Umtali	204	Apl., 1935	71,379	+ 21,377	30	450,161	340,976	+ 109,185	—	—	—	—	—
	Bilbao River & Cantabrian	15	June. 1935	1,261	— 97	26	9,905	10,459	— 554	—	—	—	—	—
	Egyptian Delta	622	20.6.35	5,135	— 451	11	41,708	42,025	— 317	Prf. Sh.	21 5/16	15 1/4	21 1/4	4
	Great Southern of Spain	104	29.6.35	1,860	+ 134	26	48,589	56,304	— 7,715	Inc. Deb.	4	3 1/2	3 1/2	Nil
	Kenya & Uganda	1,625	31.5.35	202,402	+ 11,533	21	1,127,245	1,050,349	+ 76,896	—	—	—	—	—
	Manila	—	—	—	—	—	—	—	—	B. Deb.	50	33	41	8 1/2
	Mashonaland	913	Apr., 1935	132,251	+ 38,693	30	820,037	624,162	+ 195,875	1 Mg. Db.	101	91 3/4	103	4 7/8
	Midland of W. Australia	277	May. 1935	13,048	+ 912	48	147,834	146,176	+ 1,658	Inc. Deb.	100	93	94 1/2	5 5/16
	Nigerian	1,905	25.5.35	20,681	— 4,758	8	220,920	216,201	+ 4,719	—	—	—	—	—
	Rhodesia	1,538	Apr., 1935	205,519	+ 50,699	30	1,342,580	1,063,276	+ 279,304	4 p.c. Db.	104 7/8	97 1/2	104	3 13/16
	South African	13,217	15.6.35	519,361	+ 14,314	11	5,847,131	5,258,082	+ 589,049	—	—	—	—	—
	Victorian	6,172	Feb., 1935	753,986	— 19,539	34	6,340,598	6,162,144	+ 178,454	—	—	—	—	—
	Zafra & Huelva	112	May, 1935	10,848	— 233	21	55,398	55,722	— 324	—	—	—	—	—

NOTE.—Yields are based on the approximate current prices and are within a fraction of 1/16

† Receipts are calculated @ 1s. 6d. to the rupee. § ex dividend. Salvador and Paraguay Central receipts are in currency

The variation in Sterling value of the Argentine paper peso has lately been so great that the method of converting the sterling weekly receipts at the par rate of exchange has proved misleading, the amount being overestimated. The statements from July 1 onwards are based on the current rate of exchange and not on the par value

Diesel Railway Traction

Rack and Adhesion Diesels

ALMOST from the beginning of its post-war development, the railway diesel vehicle has been used over heavy grades. For such work a high horsepower per unit of weight is necessary in order to overcome the resistance due to gravity, and in actual practice this resistance is increased frequently by the prevalence of sharp curves. Oil-engined units are at an advantage here, because of the relatively great power which can be installed within restricted confines of weight and space. In 1924 there was set to work over 1 in 16 grades in the south of Italy a 440 b.h.p. diesel-electric locomotive scaling about 47 tons, giving a ratio of 9·4 b.h.p. per ton. This unit was also arranged for use as a mobile power house, and, on the maximum grade, hauled a special motor-trailer weighing about 20 tons. The ratio for the complete train was therefore 6·6 b.h.p. per ton. The owning railway has now acquired a number of small 100 b.h.p. diesel-mechanical railcars in which full advantage has been taken of the latest developments in metallurgy and design, with the result that the power-weight ratio is 15 b.h.p. per ton of tare. These cars can maintain a speed of 25 m.p.h. up 1 in 20 grades, but their principal feature is the incorporation of rack equipment so that they can work over Strub rack sections with grades from 1 in 15 to 1 in 10. The rack mechanism is quite simple and is housed in the casing covering the normal bevel reversing gear on the driving axle. Separate braking systems are applied to the rack and adhesion mechanisms.

So far as we are aware this is the first application of the oil engine to any type of rack working, but there seems to be no reason why it should not give good service on such railways in general. The field is limited by the relatively small mileage of rack lines in the world, and of these probably a majority are electrified. The possible range is therefore limited to lines at present worked by steam, and once away from Switzerland, most steam-worked rack lines have in normal times a large proportion of goods traffic which would necessitate the use of locomotives. Unless special fuel or water problems are present, the diesel locomotive might not present any great advantage over its steam counterpart unless a whole section were to be transferred to diesel operation. But in dealing with passenger traffic over full rack or rack-and-adhesion stretches light oil-engined cars should show a considerable operating economy, by reason of the great range of possible speed due to the high power-weight ratio, and because the number of seats required per train is usually within the capacity of a single vehicle. Further, much better passenger traffic facilities may be offered and both goods and passenger traffic speeded up with little increase in cost by the separation of the goods and passenger trains from existing mixed trains.

Speed, Comfort, and Safety

WHAT is the highest speed at which a single railcar can run with safety on a well laid track? This question must have been asked whenever it was realised that practically all the diesel or petrol-engined units that have run at over 90 m.p.h. have been of the articulated type with two, three, or six vehicles. Yet the highest speed recorded, 143 m.p.h., was made by the Krackenberg car, a six-wheeler without even the supposed advantage of the double-bogie layout. From there we pass down to the 119·5 m.p.h. of the Etat Bugatti, the only other single-unit vehicle which has appreciably exceeded the hundred mark. It has been reported that this vehicle has since attained 125 m.p.h. on the same stretch, viz., between Paris and Le Mans. The Burlington Zephyr, U.P.R.R. City of Portland, and the Flying Hamburger, with respective maxima of 112, 112, and 110 m.p.h. are all articulated trains, and we must go down to the 100·2 m.p.h. of the Breda-A.E.C. car on the Italian State Railways before we come to another single-unit running alone. Of the range of articulated trains, the Nord triple-car units have run at 98 m.p.h., the Dutch triple-car sets at 90 m.p.h., the Belgian twin-unit at 88 m.p.h.; both the Flying Yankee on the Boston and Maine Railroad and the Comet on the New York, New Haven and Hartford Railroad have exceeded the hundred mark. Apparently the Danish " Lyntog " diesel trains are limited by permanent way conditions, for so far as we are aware they have not exceeded 85 m.p.h. The top speed attained with safety is not as a rule a matter of careful streamlining and the provision of adequate power; it is more particularly dependent upon the suspension, and definite knowledge on this subject for super-speed railway vehicles is not yet in an advanced state. Moreover, the top speed which may be attained without derailment is by no means the maximum which can be attained in conjunction with comfort. The Bugatti double cars on the P.L.M. Paris-Lyons and Paris-Vichy services regularly maintain the maximum speed permitted of 140 km.p.h. (87 m.p.h.), but great attention has been given to improving the riding of the earlier Bugatti models. Fortunately, in the majority of cases a high speed schedule can be worked without the necessity of attaining a maximum greatly in excess of the average, and if reasonably good riding at 85 m.p.h. or so can be obtained it will be sufficient for the most exacting schedules of the next few years, except over routes, such as that between Berlin and Hamburg, where there are considerable stretches over which the speed must not exceed 60-70 m.p.h. Elsewhere in this issue we describe tests undertaken on the P.O.-Midi Railway with a double-bogie 280 b.h.p. diesel-mechanical railcar between Tours and Bordeaux, on which the very fast schedules of the Sud Express were improved upon, and an average running speed of 75·3 m.p.h. in one direction and 76·2 m.p.h. in the other maintained without exceeding a maximum of 87 m.p.h. Given that a car can maintain such speeds with safety, and has adequate acceleration and deceleration, the main problem is to ensure that it does not knock itself to pieces in working nearly all out day after day. A definite solution can be found only by trying it, but there is no need to defer the advance from walking pace to that of a run until the decrepit stage has been reached, and the P.O.-Midi engineers are to be congratulated in, having found they could walk, deciding to proceed with more celerity. It certainly appears as if their trial sprint has been encouraging to them, for a number of double-engine 560/600 b.h.p. diesel-mechanical cars of similar design have been ordered since.

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ANOTHER GERMAN HYDRAULIC TRANSMISSION

An endeavour has been made to simplify the turbo type by combining the converter and coupling in a single unit

THE Trilok hydraulic transmission, made by Klein, Schanzlin & Becker A.G., of Frankenthal, Germany, is based on the principles of the Föttinger hydro-kinetic drive and the Vulcan hydraulic coupling, but is simplified in construction by the combination of the torque-converter and the fluid coupling in a single hydraulic circuit. The essential features of a Föttinger transformer are the driving or pump blades, the driven or turbine blades, and a stationary guide-vane reaction member which takes up the difference of torque between the pump and turbine wheels. The hydro-kinetic coupling has no guide blades and is capable only of transmitting torque which is the same for the driving and driven, or primary and secondary, wheels of the coupling.

A torque converter attains its maximum efficiency at a given transmission ratio, determined by the design, whereas the maximum efficiency of a fluid coupling is reached when the driven shaft runs at the same speed as the driving shaft, and the slip is zero. The characteristics of the torque converter and fluid coupling are thus complementary to each other, the converter providing increased torque at reduced speed of the driven shaft, and the coupling transmitting the driving torque at nearly the speed of the driving shaft. In order to combine these two functions in a single apparatus, it is necessary to arrange that the part used as a stationary guide vane or reaction member in the torque converter can operate as an additional turbine runner when the apparatus works as a fluid coupling.

Properties of Trilok Transmission

In the Trilok transmission two free-wheel devices are used respectively to couple the dual-purpose member to the stationary casing when it is to act as reaction member (torque-converter), and to the driving shaft when it is to act as turbine runner (fluid coupling). The change from one condition to the other is effected automatically and at exactly the correct moment. Referring to Fig. 1, the pump impeller *P* is attached to the driving shaft *A*; the turbine runner *T* is keyed to the driven shaft *B*; and the dual-purpose wheel *S*, completing the hydraulic circuit *PTS*, is carried by a hollow shaft with freewheel devices at *C* and *D*. The rotating parts are carried by a stationary casing *F*, which also serves as container for the hydraulic medium. A small gear-pump *G* keeps the circuit *PTS* filled with oil under slight pressure, and also lubricates the bearings and freewheel mechanism.

When the resisting torque on shaft *B* is greater than the torque applied by shaft *A*, the guide vane member *S* tends to rotate backwards, but this is prevented by the mechanism *C* locking the hollow shaft of *S* with the fixed casing *F*. The part *S* is thus held stationary and acts as a reaction member, the transmission now being on the torque converter principle. As the torque required by *B* decreases, the speed of this shaft rises; and directly the required driving torque becomes less than the applied

Fig. 1 (Below): Longitudinal section through Trilok combined torque-converter and fluid coupling

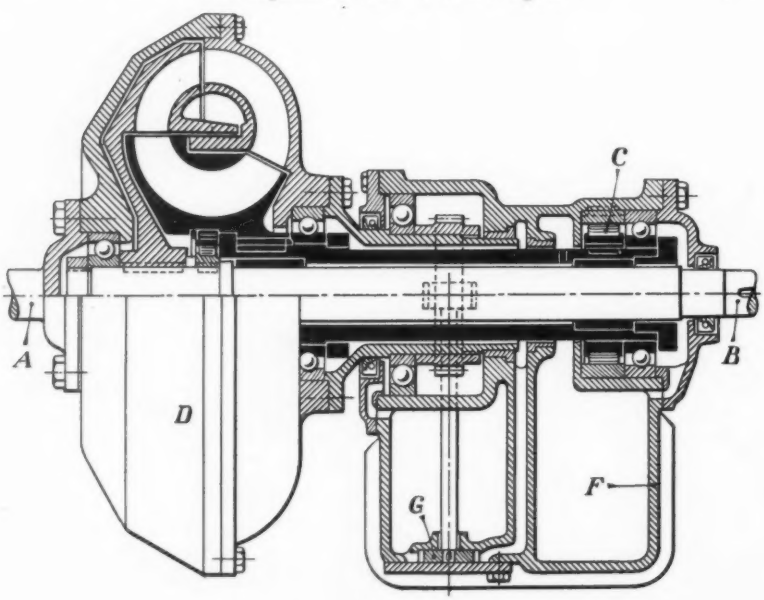
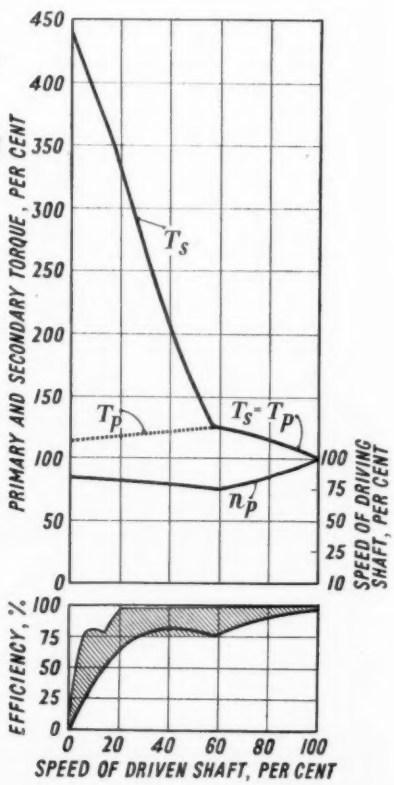
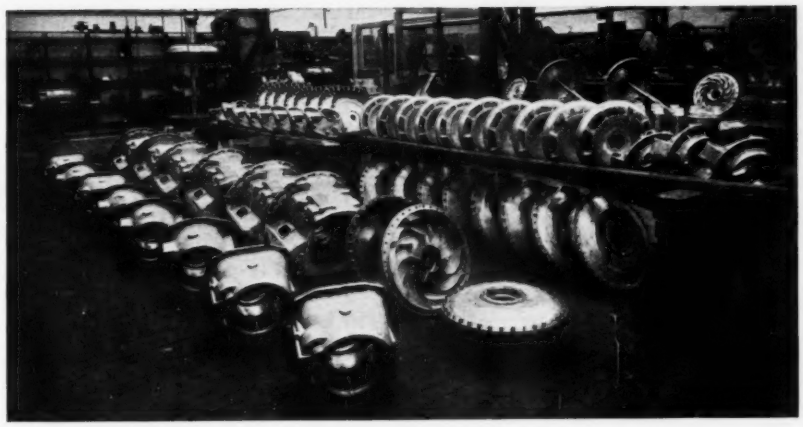


Fig. 2 (Right): Operating characteristics of Trilok hydraulic transmission used in conjunction with a diesel engine



Right: A series of Trilok hydraulic transmission sets being assembled in the works of the maker



Below: Outside view of a 250 b.h.p. Trilok transmission designed for use in a diesel railcar

torque, the torque reaction on S reverses and this part begins to run forward in the same direction as B. The design is such that the speed of S rises rapidly, but it is prevented from overtaking B by the action of the mechanism D, which locks S to B and causes it to act as an extension of the turbine runner T. The transmission now operates as a fluid coupling without conversion of torque. Whenever the load-torque exceeds the driving-torque, S falls behind B, comes to rest, tends to run backwards, and is again held by C, thus restoring the torque-converter action. The technical innovation in the transmission is the member S with its two locking devices, which enable the transmission to operate as a torque converter or a fluid coupling, according to the requirements of the load.

The torque characteristics of the Trilok transmission in conjunction with an internal combustion engine are shown in Fig. 2. The primary and secondary torques, T_p, T_s, as percentages of the torque at rated speed, are plotted against the speed of the driven shaft expressed as a percentage of its rated (direct-drive) value. The primary speed n_p, and the efficiency of the transmission are also plotted on the same base.

The efficiency varies with the load and speed, the range of variation being indicated by the shaded area in Fig. 2. The heavy curve represents the full-load efficiency. The efficiency is higher at fractional loads and then often exceeds 98 per cent. The starting torque is 4·4 times the rated direct-drive value in the case represented by Fig. 2, and considerably higher starting torque can be obtained if required.

In common with other hydraulic machines, the Trilok transmission obeys the hydraulic laws of similarity. A change in the driving speed produces a proportionate change in the secondary speed; and the torques vary with the square of the speeds. At low speeds, *e.g.*, the idling speed of an internal combustion engine, the torque transmission is practically zero; the transmission then acts as a disengaged coupling and it is impossible to stall the engine. Similarly, the engine can be started light, even though the output side of the transmission be held stationary. Any desired vehicle speed from zero to maximum is obtained simply by moving the engine throttle, the hydraulic transmission adapting itself automatically to every change in tractive resistance and load. No operating rods or other control connections are needed on the transmission, and there is no interruption of torque transmission or tractive effort. The addition of a simple device permits the engine to be used as a brake.

THE MAINTENANCE OF FUEL TANKS AND FILTERS

ALTHOUGH bad workmen have a habit of grumbling at their tools, disappointing results may be due to lack of knowledge rather than lack of skill. This has been proved in the handling of fuel, where many pump and filter complaints arise simply because the operators were not sufficiently grounded in the care and maintenance of injection equipment and the bunkering and handling of oil fuel. After examining the question both in this country and on the Continent during a period of some six or seven years, C.A.V.-Bosch Limited, has made the following recommendations.

It is to be emphasised in the first place that the purchase of unknown and/or inferior brands of fuel oil may lead to troubles and expense just as serious as those resulting from the use of unsatisfactory lubricating oils. Different types of engines require different types of fuel oil, but all classes can be purchased in reliable specifications. The bigger the quantity of fuel bought at one time the better. In no circumstances should sump oil, waste petrol or paraffin ever be added to fuel storage tanks.

Fuel Storage

Tanks for storing fuel are usually of two types; (1) overhead, in the shed or open air, when rectangular or cylindrical steel tanks are used, and (2) underground, when steel tanks of cylindrical section are more often employed. The latter position gives greater economy of space,

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whilst the overground type costs less to instal and is more accessible. Whichever type is chosen, however, the tank should be well designed, fabricated of good material, and properly installed. In this connection it is wise to remember, if changing over from petrol to oil fuel, that oil must under no pretext be put into tanks previously containing petrol until they have been thoroughly cleaned. First, all dirt should be removed, then all scale and sediment scraped away, walls, pipes and fittings thoroughly washed and scrubbed with paraffin, and finally the tank walls rubbed down with clean, smooth rags.

Underground Tanks

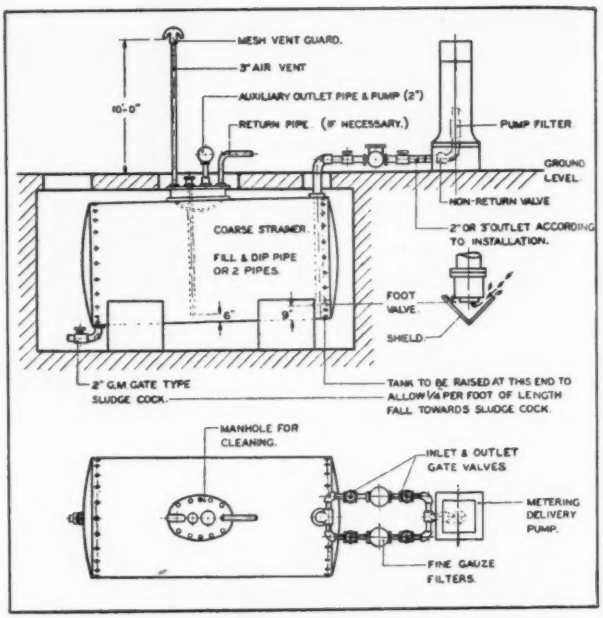
Underground oil fuel storage tanks should be installed in a pit of at least twice the capacity of the tank. They should be mounted on brick or concrete cradles so that longitudinally they are nearly horizontal. A good quality steel plate, at least $\frac{3}{16}$ in. thick, is recommended for all tanks, the thickness increasing with the volume to be stored, and welded construction, externally galvanised, is recommended. The Utopian arrangement here illustrated is of an underground tank and its fittings, but the details enumerated are equally applicable to overhead tanks. The fill and dip pipe (which may be two separate pipes), has a $2\frac{1}{2}$ in. inside diameter screwed male British standard gas-thread, fitted with gunmetal cap, chain and padlock. A coarse gauze strainer can be fitted in the gunmetal valve pipe, which projects about a foot above the manhole top and will descend to within 6 in. of the tank bottom. There is an air vent pipe with a 3 in. inside diameter with uptake, and in the case of an underground tank, this is well above ground level (say 10 ft.). A wire cage guard should be fitted to the vent at the top of the pipe; wire gauze should not be used as it quickly clogs with dirt. The suction pipe of an underground tank should descend to about 9 in. from the bottom and be fitted with a foot valve, which in turn should be guarded by a conical shield, to prevent sludge being sucked up from the bottom of the tank. This pipe should be taken off the tank, preferably at one end, the higher end in the case of a tank having a recommended inclination of at least $\frac{1}{4}$ in. to the foot. Its diameter should not be less than $1\frac{1}{4}$ in., and provision should be made for a return pipe of at least 3 in. inside diameter where the type of delivery pump installed requires this. A sludge gate valve not less than 2 in. should be provided in the tank bottom, remote from the suction pipe end, and in some installations it may be considered wise to fit an auxiliary suction with a hand semi-rotary pump fitted, to allow water to be pumped off in emergency, such as the breakdown of the delivery pump.

One central oval cleaning manhole, not less than 16 in. in length, is recommended, to be bolted on with asbestos joint. Filter pipe, dip pipe, air vent pipe, and auxiliary suction pipe fittings may be passed through this manhole cover. Sludge and water should be drawn off once a week, and the tank emptied and cleaned annually, if not more frequently.

Rail Vehicle Tanks

It is essential that the filling funnel should be provided with a coarse metal gauze filter and a reliable cap, kept closed. The continual running of vehicles in a dusty or loaded atmosphere creates in time an accumulation of harmful abrasives in the fuel tank, and these being constantly stirred up by the motion in the vehicle, might cause trouble, should the filter between the tank and the injection pump be neglected.

Between the vehicle tank and the filter is a pipe, generally of copper, and this is thoroughly cleansed inside



Underground type of fuel storage tank as recommended by C.A.V.-Bosch

before being placed in position at the factory. Should it be removed during overhaul, and fall to the ground, it should never be rebent or replaced without first being thoroughly cleansed in paraffin and blown through with clean high-pressure air.

Care of the Filter

The C.A.V.-Bosch filter is the outcome of many years of development and research with all types of filtering media, such as paper, cork, sponge, wire gauze, monel metal and metal plates, and the resultant fabric element now used has been found in practice to be the best so far as the protection of injection equipment is concerned. Therefore, should an operator find his filter clogged, or requiring attention more frequently than once weekly, he is advised not to exchange it for an element such as wire gauze, but to alter his method of bunkering or handling the fuel, which may be at fault. It may also be that he is ordering his supplies from a bad source, and this should be remedied. Spare filter elements are obtainable for a nominal sum, and it is better to spend a few coppers and a short time on regular attention to a filter than to run the risk of foreign matter getting through the pipes to the injection equipment, which would involve loss of vehicle earning time and possibly render an extensive and costly overhaul of the injection equipment necessary.

Once a week the filtering element should be removed bodily from the filter, plugged both ends with corks, and thoroughly rinsed out in clean paraffin. There is no need to scrape it with a knife or brush it, nor should it be immersed in a solution of paraffin and water containing sludge and dirt. Some companies provide new filter fabrics every two weeks or so, and use up the discarded ones as garage rags.

Final instructions include a warning not to pour unfiltered fuel into the autovac, which in many engines is situated between the filter and the pump. The pipes lying between these two elements need as much care as those between the tank and the filter, and the same remarks apply.

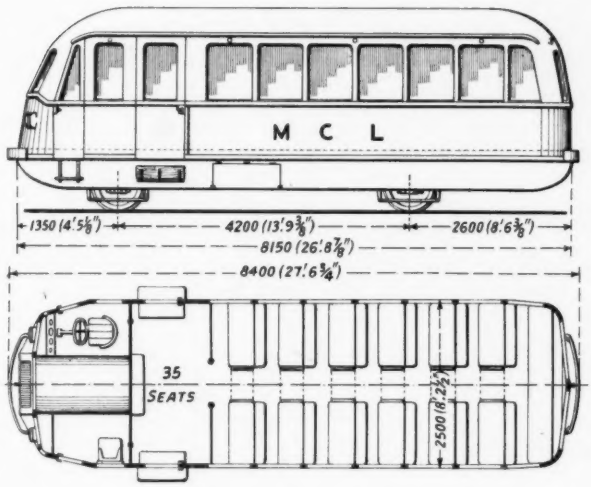
DIESEL RAILCARS FOR MIXED RACK AND ADHESION WORKING

Light Italian vehicles have a ratio of 15 b.h.p. per ton of tare

THE Società delle Ferrovie Calabra-Lucane is an important private line in the south and south-east of Italy. The track is 950 mm. gauge (37·4 in.) and is laid almost everywhere over hilly ground with gradients up to 1 in 16 worked by adhesion and rack sections up to 1 in 10.

A 440 b.h.p. diesel locomotive was introduced in 1924, and steam traction is now being replaced by diesel railcars on a more extensive scale. The first of the new cars are at work between Bari and Montalbano, 87 miles, and from Cosenza to Catanzaro-Città, 68 miles. They were built by the Soc. Italiana Carminati & Toselli and are of the two-axle type specially designed to meet the conditions of mountainous lines, where, in order to obtain a reasonable speed, it is necessary to reduce the tare weight and increase the power-weight ratio. Light alloys were therefore adopted, except for highly-stressed parts, which are constructed of high-tensile steel. In view of the sharp curves (5 chains radius), and in order to permit of a relatively high speed over them, the car wheelbase is only 4·2 m. (13 ft. 9⅜ in.). The tare weight is 6·6 tonnes and the gross weight 9·6 tonnes. The axles are supported on S.K.F. roller bearings.

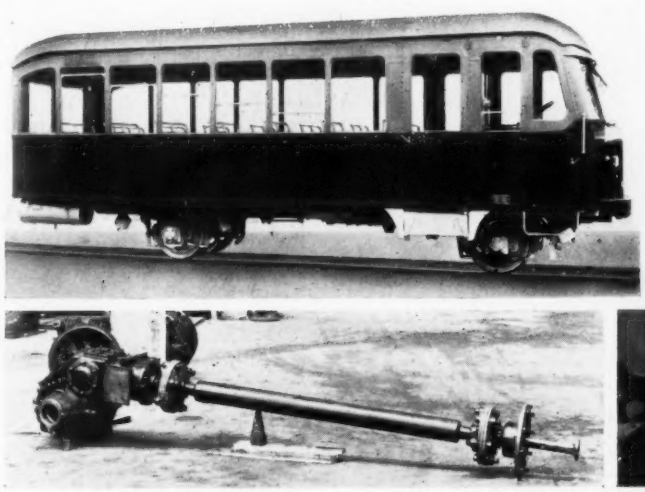
The underframe is of steel and the body of light alloys, Avional having been used for the framing and Anticorodal for the outside panels. The interior is lined with aluminium sheets 10 mm. (0·39 in.) thick, and the interspace is filled with cork conglomerate. At the joints between the steel underframe and the alloys, a pure zinc insulator has been interposed to prevent galvanic action. The door handles are connected by levers with fold-up stairs. The window frames are of light alloy, and the windows themselves are of the drop type, with safety glass. The brakes are of the Westinghouse type, the air being supplied by a two-cylinder compressor, driven from the engine. There is a handbrake and on some of the cars an electromagnetic brake has been fitted, current being supplied by the accumulators installed for the starting of the engine and lighting the car.



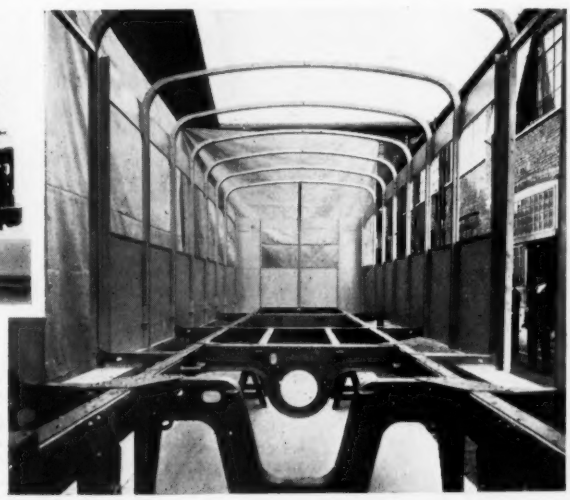
Arrangement of 100 b.h.p. diesel car for rack and adhesion lines

The 100 b.h.p. six-cylinder Saurer-type engine was made under licence by the Officine Meccaniche di Brescia. It is mounted on a subframe at the leading end of the car, and weighs 900 kg. (1,984 lb.). The cylinders have a diameter of 110 mm. (4·33 in.) and a stroke of 150 mm. (5·9 in.). The four-speed gearbox is secured directly to the engine, and a long cardan shaft with flexible couplings leads from it to the bevel reversing gear which drives an elastic gear wheel on the rear axle, the reversing bevels and final pinion and gear wheel being in one casing.

In order to employ the cars on rack lines, the axles are equipped with a co-axial spring-mounted toothed wheel which is operated by the same transmission gear. A special gear enables the toothed wheel to run loose when the car travels on ordinary track. Hand and Westinghouse brakes act upon the toothed wheel, which is also equipped with a hand-operated band brake. The speed of the cars on the level is 75 km.p.h. (46·6 m.p.h.) and over gradients of 1 in 20, 42 km.p.h. (26 m.p.h.). Ten diesel-electric railcars of 250 b.h.p. are now being put in service on the main lines of the Calabra-Lucane company.



Top left : General view of Calabra-Lucane car taring 6½ tons
Bottom left : Cardan shaft and reversing gear



Above : Construction of body framing and underframe of 100 b.h.p. car for 950 mm. gauge mountain lines

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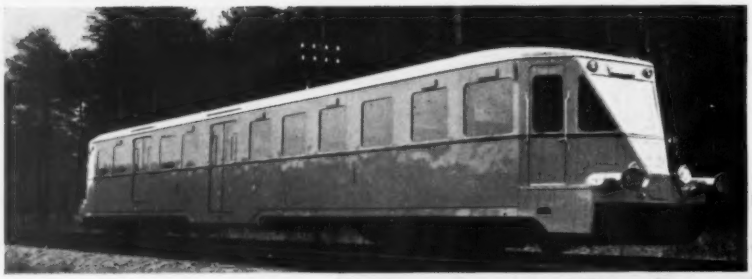
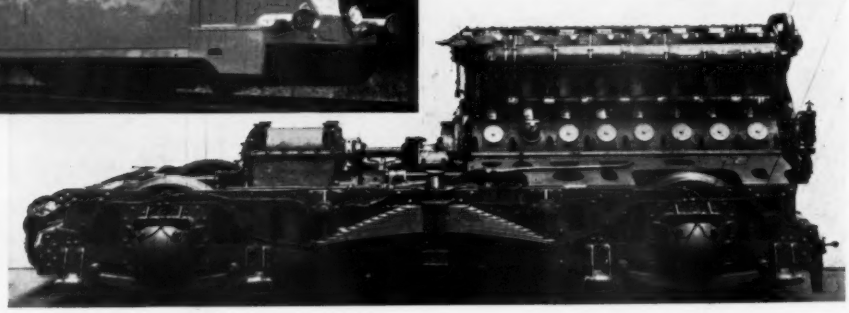
EXPRESS DIESEL RAILCARS ON THE P.O.-MIDI RAILWAY

High-speed trials on the basis of the Sud Express timing have been conducted between Tours and Bordeaux



Double-bogie Acenor diesel railcar as used in high-speed tests between Tours and Bordeaux

Below: M.A.N.-type 280 b.h.p. engine and SLM-Winterthur oil-operated mechanical transmission mounted directly on the bogie

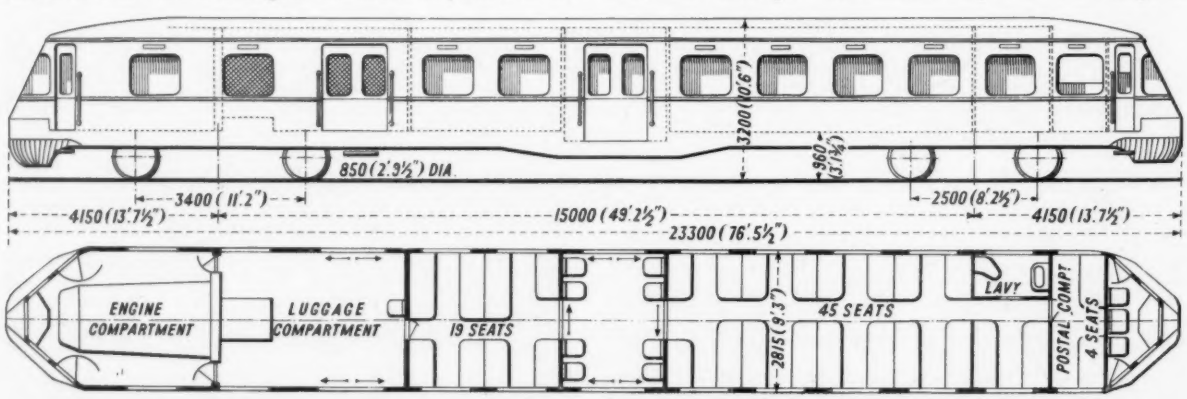


AMONG the diesel stock of the P.O.-Midi Railway are four double-bogie cars with a single engine and mechanical transmission which were built by the Aciéries du Nord, and designed to be suitable for operation at the French legal maximum speed of 120 km.p.h. (74·6 m.p.h.). These vehicles have proved satisfactory over a period of some months, and the same builder has received an order (recorded in THE RAILWAY GAZETTE for May 24, 1935) for 41 similar vehicles, but most of which will have two engines, for the Nord, Est, and P.O.-Midi Railways. Some of the new cars will have two 210 b.h.p. M.A.N. engines, built under licence by the Aciéries du Nord, and the others will have two Renault 250 b.h.p. engines.

The four P.O.-Midi cars which have been in service for some time are Nos. ZZPEty 23.811-814, and are shown in accompanying illustrations. The seating accommodation is all of one class and totals 64 seats plus four seats in the postal compartment. Lavatory accommodation is provided and there is a luggage compartment with a capacity of two tons, as well as the small postal compartment. There is a driving position at each end, and side buffers and the usual drawgear are fitted to permit of the haulage of one trailer of ordinary stock, with a maximum weight of 25 tons. When not in use the drawgear is enclosed by a light hinged cover.

The car is heated by the exhaust from the engine, but a useful connection is provided whereby the heating circuit can be coupled to an outside steam supply and the vehicle warmed up before starting the day's work. Lighting is by electricity, and this and the engine starting motor are supplied with current from a Tudor nickel-cadmium battery of 318 amp. hr. capacity. The axles of both the driving and trailing bogies are carried in S.K.F. roller bearings. Braking is on three systems, *viz.*, a foot-operated hydraulically-controlled air brake of the Westinghouse type applying two blocks on each wheel; an electromagnetic brake applying shoes to the rail; and a handbrake. The air brake is of the automatic pattern, so that the brakes on the trailer are applied simultaneously. The empty weight of the car, but with supplies, is 36·7 tonnes and the fully-laden total, with a full complement of passengers, 44 tonnes.

An eight-cylinder Acenor engine (M.A.N. type, built under licence by the Aciéries du Nord) forms the power unit, and develops a continuous output of 280 b.h.p. at



1,400 r.p.m., and a maximum of 300 b.h.p. at 1,500 r.p.m. The cylinders have a bore of 175 mm. (6·91 in.) and a stroke of 180 mm. (7·1 in.) The engine is mounted on the driving bogie and is coupled to a five-speed gearbox of the SLM-Winterthur type with hydraulic clutches and gears always in mesh, as described in the issue of this Supplement for November 2, 1934. The final drive from the gearbox to the two axles is by means of bevels. The radiators for cooling the engine circulating water and lubricating oil are located at each end of the car below the buffers, and are supported by the steel underframe-body unit.

Trials with one of these cars were conducted in March between St. Pierre des Corps and Bordeaux in both directions, and in addition to high speed runs with the Sud Express timing as a basis, acceleration and deceleration tests were undertaken. On the down run the car was accelerated from rest to 138 km.p.h. (86 m.p.h.) in 5½ km. (3·41 miles), nearly all of which was up 1 in 200. The top speed reached in the course of the tests was 140 km.p.h. (87·3 m.p.h.). As shown by the accompanying table, the

	Speed	Stops	
		Railcar alone	With trailer
On the level ..	120 km.p.h. (74·6 m.p.h.)	370 m. (1,215 ft.)	—
On the level ..	100 km.p.h. (62 m.p.h.)	—	330 m. (1,080 ft.)
Downgrade of 1 in 66	90 km.p.h. (56 m.p.h.)	238 m. (785 ft.)	—
Downgrade of 1 in 66	80 km.p.h. (49·6 m.p.h.)	—	224 m. (735 ft.)
Downgrade of 1 in 40	70 km.p.h. (43·5 m.p.h.)	160 m. (525 ft.)	200 m. (660 ft.)

schedule of the Sud Express was improved upon in each direction, but, of course, the French legal maximum speed of 120 km.p.h. (74·6 m.p.h.) was waived.

When running alone, the railcar reached a maximum speed on the level of 133 km.p.h. (82·8 m.p.h.) and when hauling a trailer, 110 km.p.h. (68·3 m.p.h.). Up 1 in 200 the top speeds were 111 km.p.h. (69 m.p.h.) running alone, and 85 km.p.h. (52·8 m.p.h.) with trailer; on a 1 in 40 grade the speeds were 56 km.p.h. (34·7 m.p.h.) and 32 km.p.h. (19·8 m.p.h.) respectively. Interesting results were obtained in the course of the deceleration tests, when using the electro-magnetic and air brakes simultaneously, and some of the stops are given in the accompanying table.

TIMINGS AND FUEL CONSUMPTION OF TRIAL RUNS BETWEEN BORDEAUX AND TOURS (ST. PIERRE DES CORPS), P.O.–MIDI RAILWAY, WITH A 280 B.H.P. DIESEL RAILCAR

	Bordeaux (St. Jean)-Angoulême	Angoulême-Poitiers	Poitiers-St. Pierre des Corps
Distance .. .. km.	133	113	103
Actual running time of railcar .. min.	66	55	50
Average speed of railcar km.p.h.	121	123·2	123·6
Schedule time of Sud Express .. min.	84	70	60
Average speed of Sud Express km.p.h.	95·2	97	103
Fuel consumption of railcar .. .. litres	67	57	50
Fuel consumption of railcar, litres per 100 km.	50·4	50·4	48·5
	St. Pierre des Corps-Poitiers	Poitiers-Angoulême.	Angoûeume Bordeaux (St. Jean)
Distance .. km.	103	113	133
Actual running time of railcar .. min.	51·5	54·0	67·0
Average speed of railcar .. km.p.h.	120	125·5	119
Schedule time of Sud Express .. min.	62	60	87
Average speed of Sud Express km.p.h.	100	113	92
Fuel consumption of railcar .. litres	49·5	53·5	61·5
Fuel consumption of railcar, litres per 100 km.	48·3	46·5	46·2

Publications Received

Diesel Locomotives and Railcars. By Brian Reed. London: The Locomotive Publishing Co. Ltd., 3, Amen Corner, E.C.4. 8¾ in. × 5½ in. 190 pp. Illustrated. Price 6s. net.—A few months ago Messrs. Pitman published a work of Dutch origin on internal-combustion railway traction, but by the time this work was available in English, it was some three years out of date. During the last three years an enormous amount of development has culminated in the production of new engines, particularly of the high-speed diesel type, new transmissions, particularly of the mechanical and hydraulic varieties, and several light high-speed trains working to schedules previously deemed impossible on a railway. The new book so obviously needed to put all these happenings on record has now appeared, and in only one respect does this book, the subject of the present review, fall short of the times. On pp. 63 and 64 the author makes some remarks about steam locomotives which must now occasion him some regret, as, so far from showing itself beaten by its rivals, the steam locomotive has within the last few months shown itself to be capable of maximum speeds well over 100 m.p.h. and of long-distance averages considerably in excess of 70 m.p.h., even in its present form. New types are being developed, moreover, which are almost certain to set new standards of performance for steam trains and diesel trains alike. What remains to be seen, of course, is comparative costs over a long period. In his selection of early examples of diesel locomotives and railcars, the author has shown commendable restraint, and in Chapter II, which forms the historical part of his book, he has preferred to outline the development or evolution of the present-day designs, rather than provide a lengthy summary of early experiments. In Chapter I the advantages of diesel traction are assessed, many tables being given to show the operating costs in actual service of various kinds of diesel unit. In some instances comparative figures are given for equivalent steam units. Chapter III deals with railway requirements, and it is predicted that schedules well over 65 m.p.h. must be maintained by the long distance expresses of the future. Then follow the remarks about steam locomotives mentioned above. Chapter IV affords illustrated descriptions of some of the most trustworthy diesel engines in railway service, while Chapter V deals with engine auxiliaries. In all Europe there is probably no man better qualified than the author to select material of this kind. Little, indeed, can have happened during the past few years without his knowing it, and the chapters here mentioned, together with the last four which deal with transmissions, form without doubt the best "What's What" yet compiled for the student of diesel railway traction. Chapter VI is a comparative study of mechanical, hydraulic, and electric transmissicn systems, while chapters VII, VIII arod IX provide illustrated and more detailed descriptions of the systems discussed, all the important examples of each receiving consideration. Much interest has been aroused by the fluid flywheel in its more advanced forms, and in the Wilson gearbox. These are fully described, together with the even more unconventional Voith-Sinclair and Lysholm-Smith partial-hydraulic transmissions. The book closes with an appendix on the resistance of diesel vehicles and a good index, the latter being very necessary in a work of this kind. Clear printing and good quality paper bound in a gilt lettered, red cloth cover, give this book an attractive appearance, and the price is well below the figure one would expect to pay for such a volume.

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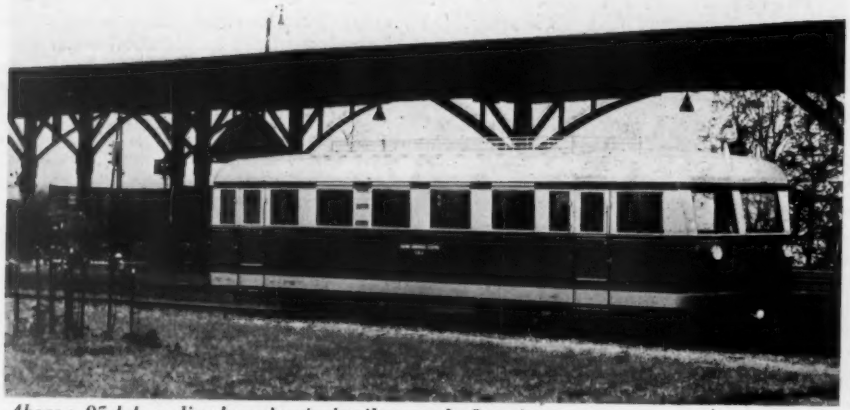


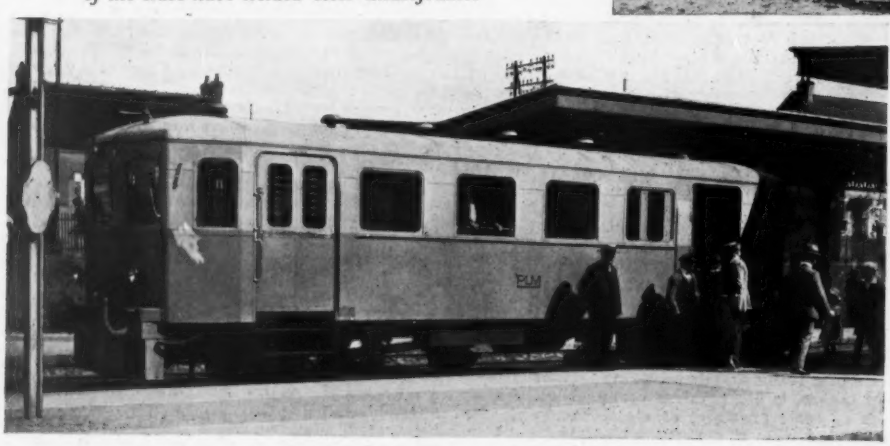
Above: 95 b.h.p. diesel-mechanical railcar on the Lüneburg-Soltau Railway

Top right: Front view of four-wheeled diesel railcar on the Niederbarnimer Railway, Berlin

Right: Light 85 b.h.p. diesel-mechanical railcar on the Jokiosten Railway, Finland

Above: 95 b.h.p. railcar on the narrow-gauge Hummlinger District Railway

Right: 120 b.h.p. four-wheeled diesel-mechanical car on the standard-gauge lines of the Czechoslovak State Railways. The car runs on SKF roller bearings, and some of the class have welded steel underframes

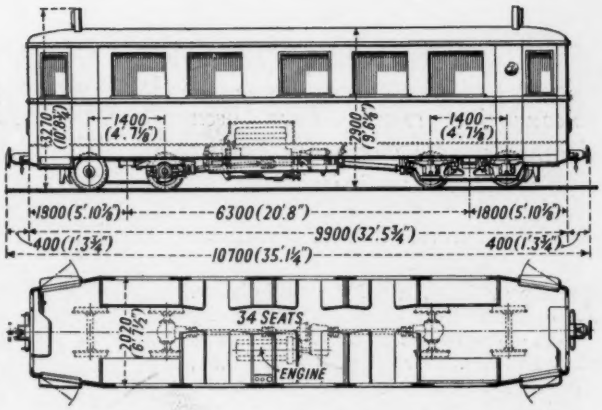


Left: P.L.M. 38-seater four-wheeled diesel-mechanical railcar at Auxerre station. The car is powered by a 120 b.h.p. Saurer engine, and was built by the Cie. Française de Materiel de Chemin de fer. Between Laroche and Avallon four steam train services have been replaced by ten diesel services worked by two of these cars

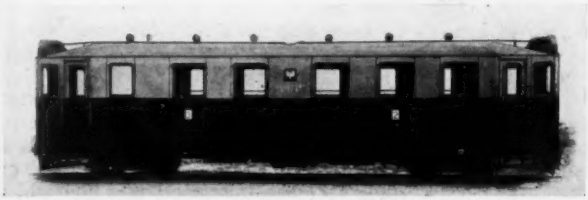
A SELECTION OF DIESEL RAILCARS RECENTLY SET TO WORK ON THE CONTINENT

Small European Railcars

IT is not generally realised to what an extent diesel traction has found favour over the length and breadth of Europe on small private lines. Indeed, many of them have been saved from financial crisis by the adoption of light oil-engined cars, paid for, in some cases, on the instalment plan. In Germany, especially, a large number of four-wheeled cars are at work on the numerous private light railways. The standard-gauge Lüneburg-Soltau Railway, for instance, has had in service for over a year a 95 b.h.p. railcar with a 95 b.h.p. Daimler-Benz engine and Mylius gearbox. A car with a similar engine and transmission has been acquired also by the Isergebirgsbahn, after experience extending over 18 months with a 65 b.h.p. vehicle. The new car, illustrated on this page, tares 12 tons and seats 50 passengers; the wheelbase of 20 ft. 4 in. is not rigid, as radial axles are fitted.



Proportions of 95 b.h.p. railcar as used on 750-mm. gauge lines in Germany, Poland, and Finland

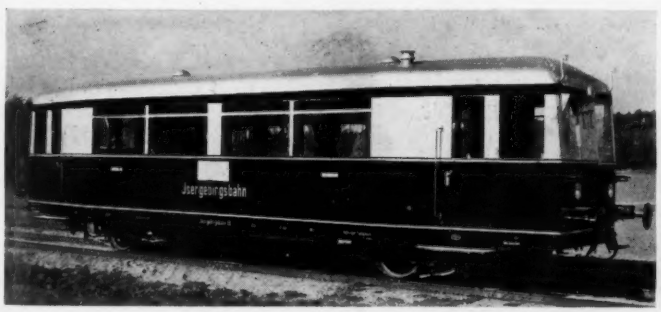


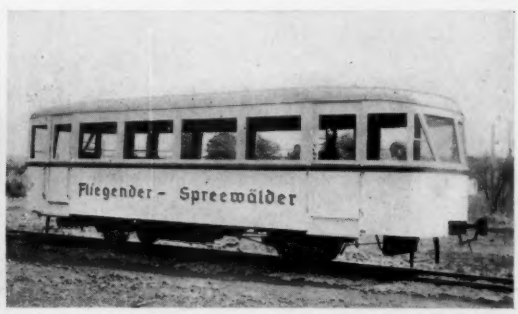
750-mm. gauge railcar with 85 b.h.p. Saurer engine on the Polish State Railways

This vehicle works over a line only seven miles long with 1 in 40 grades; Knorr air brakes are used. Other lines having cars with the same make of engine and transmission are the Zschipkau-Finsterwalder, Thüringische, Rhein-Sieg, Eutin-Lubecker, and Wittlager Railways.

The Hohenzollerischen Landesbahn has set to work two four-wheeled diesel cars, each with a 150 b.h.p. M.A.N. engine and Mylius geared transmission driving both axles, and a special trailer is hauled up grades as steep as 1 in 36 with curves of 800 ft. radius. Also fitted with Mylius transmission (see *Diesel Railway Traction Supplement*, January, 1935) are a heavier car with a 110 b.h.p. Deutz engine on the Halberstadt-Blankenburg Railway, which has 1 in 16 grades; an 85 b.h.p. Daimler-engined eight-wheel car on the 750-mm. gauge Jokiosten Forsan Railway in Finland; an 85 b.h.p. Saurer-engined car of the same general type and gauge on the Polish State Railways; and a 75 b.h.p. car with Deutz engine on the 750-mm. gauge Hummlinger District Railway. Another small German car is the *Flying Spreewalder*, built by the Waggonfabrik Talbot A.G. It runs on the Spreewalderbahn and is powered by a 65 b.h.p. Daimler engine.

Among the smaller-powered diesel-geared cars put into traffic on the Czechoslovak Railways are some with the driving position in a conning tower. They have 120 b.h.p. engines and carry 42 passengers on a tare weight of 12½ tons; the maximum speed is 37 m.p.h., and the brakes are of the Knorr type.

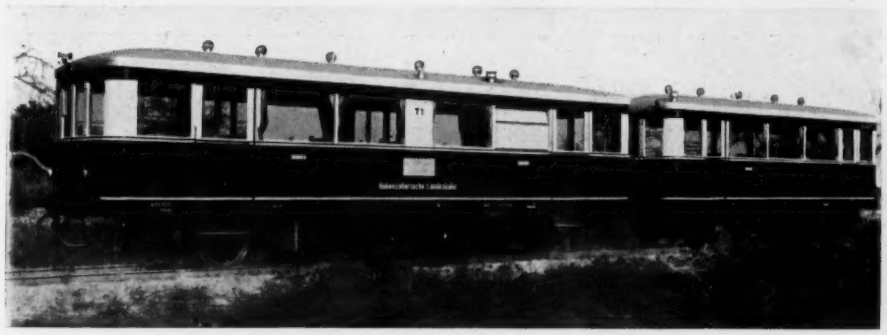




Above: 95 b.h.p. diesel car with Daimler engine on the Isergebirge Railway

Top right: 65 b.h.p. car on the Spreewald Railway

Right: 150 b.h.p. M.A.N.-engined railcar with special trailer on the Hohenzollerischen Landesbahn



SERVICE OPERATION OF AN L.M.S.R. DIESEL SHUNTER

Encouraging results have been obtained with a locomotive having electric transmission

*By L. H. SHORT, M.C., A.M.I.E.E.**

300 b.h.p. diesel-electric shunting locomotive at work in a big goods yard on the L.M.S.R.

IN April, 1934, a 47-ton 300 b.h.p. diesel-electric locomotive, built by the English Electric Co. Ltd. was placed in trial service on the L.M.S.R., the ownership still remaining with the builders. At the beginning of the present year it was purchased by the L.M.S.R. after an order for ten similar locomotives had been placed. Since going into traffic this unit has been performing generally on a 24-hour service for 6½ days a week. and has now completed over 4,000 hr. of work, including regular shunting duties at Crewe, Beeston, Salford, Rugby, and other L.M.S.R. yards and sidings, where, besides performing in an exemplary manner, it has proved itself superior to the steam locomotive in availability, reliability and efficiency of operation. Extracts from the running log of this locomotive at three different centres is shown in the table at the foot of this page.

The following table, culled from a Teloc chart of an actual day's shunting duty, gives an idea of a typical day's work. In this case fairly heavy freight trains had to be hauled out of sidings up a gradient of 1 in 145 and then broken up by shunting from the top and distributed into the various sidings below:—

Actual engine running hr.	20
Total number of movements	354
Total distance covered	44·5 miles
Average speed in operation	5 m.p.h.
Average weight of train hauled	110 tons
Maximum weight of train hauled	750 tons
Approx. total ton-miles, including locomotive weight	7,000
Fuel consumption for 24 hr.	52·7 gal.
Total lubricating oil consumption	2·5 gal.
Engine cooling water make up	1·5 gal.
Approx. ton-miles per gal. of fuel	133

Examination of Components

When the diesel engine had completed 3,000 hr. running, an examination of the mechanical and electrical equipment of the locomotive was made. The pistons and piston rings were in excellent condition and wear on the cylinder liners was negligible. Careful checking of the big-end bearings showed that they retained their original clearance of 0·007 in.; the surface bedding was good and the white metal bearings showed no sign of cracks or blemishes. The small-end bearings were in equally good condition and retained their original clearance of 0·004 in. The lubricating oil was chemically analysed for dilution, and this was found to be less than 1½ per cent., showing little change from the original. It appears from the periodic examinations that it will not be necessary to change the lubricating oil as a whole more often than once in every year's working.

The following inspection periods have been decided upon as a result of running experience and examination:—

	Engine running hr.
Exhaust valves regrinding	1,000/1,500
Inlet valves regrinding	2,000
Fuel injection valves regrinding	1,500
General overhaul, piston and big-end examination, &c.	annually (5,000 to 6,000 hr.)

A detailed examination of the electrical equipment disclosed that the main and auxiliary generator and driving motor commutators were in excellent condition and showed no signs of flashing or sparking. The electrical contactors were also in good order. It was accordingly decided that two or three hours' weekly maintenance was adequate to maintain the apparatus in first class condition.

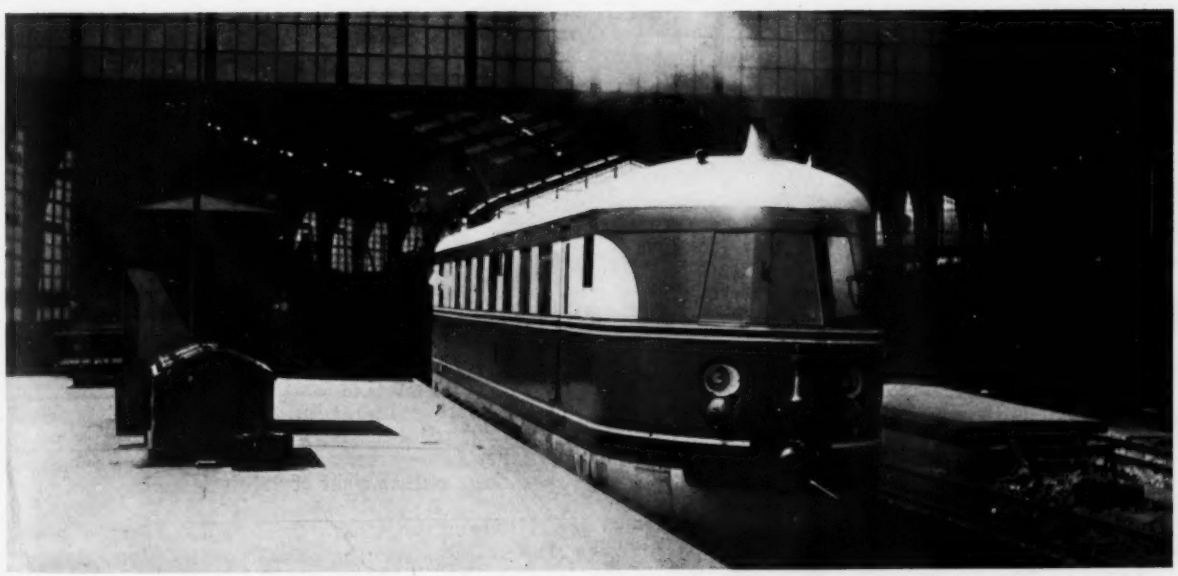
* In an article in the January, 1935, issue of *The English Electric Journal*.

REPRESENTATIVE EXTRACTS OF RUNNING DATA FROM LOG BOOK OF 300-B.H.P. DIESEL-ELECTRIC LOCOMOTIVE

Week ending 1934—	Mileage	Loco. working hr.	Engine running hr.	Engine fuel, gal.	Fuel, m.p.g.	Fuel, gal. per hr. engine running	Lub. oil gal.	Cooling water, gal.
Shunting Duty at Crewe Yard, L.M.S.R.								
April 28	178	109	99	247·5	0·72	2·5	12·5	9
May 5	179	99·6	92·7	274	0·655	2·75	7·5	5
May 12	199	109·25	99·75	306	0·65	3·07	12·5	10
Shunting Duty at Camden Yard, North London, L.M.S.R.								
July 14	225	151	126	317	0·710	2·52	18	5
July 21	195	150	124	325	0·60	2·62	18	3½
July 28	205	151	125	312	0·658	2·5	21	4½
Shunting Duty at Salford Yard, nr. Manchester, L.M.S.R.								
October 6	195	140	128½	309	0·634	2·40	14	6
October 13	213	134½	120	310	0·687	2·58	17	9
October 20	174	130	119	286	0·610	2·38	16½	7½

MORE FRENCH CARS WITH ELECTRO-MECHANICAL TRANSMISSION

The Northern Railway of France has just taken delivery of two diesel railcars built by Baudet, Donon & Roussel. They are powered by two 150 b.h.p. Saurer engines running at 1,500 r.p.m., and are fitted with electrically-operated mechanical transmission of the Cotal type giving four speeds in each direction. The final drive is by chains. The cars carry 62 seated passengers on a tare weight of about 34 tonnes, and have a top speed on the level of 100 km.p.h. (62 m.p.h.). The roller bearings are of the SKF type, and oil-pneumatic and hand brakes are provided



The Fliegende Kölner, the express diesel-electric train which started a fast return service between Cologne and Berlin on July 1, at Friedrichstrasse station. It has two Maybach 410 b.h.p. engines, and in general is an improved form of Flying Hamburger. This service was described in the "Diesel Supplement" for April 19, 1935

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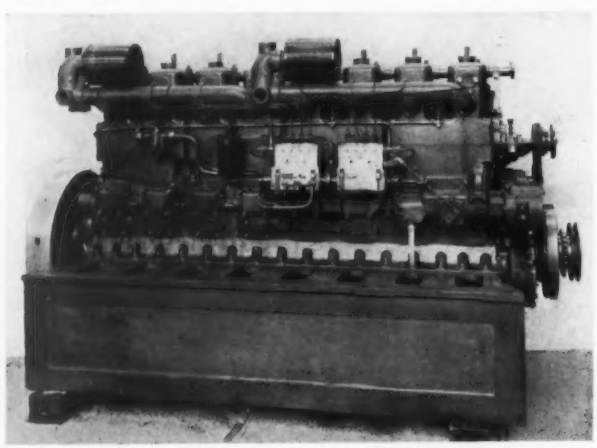
A DIESEL LOCOMOTIVE FOR BARREN COUNTRY

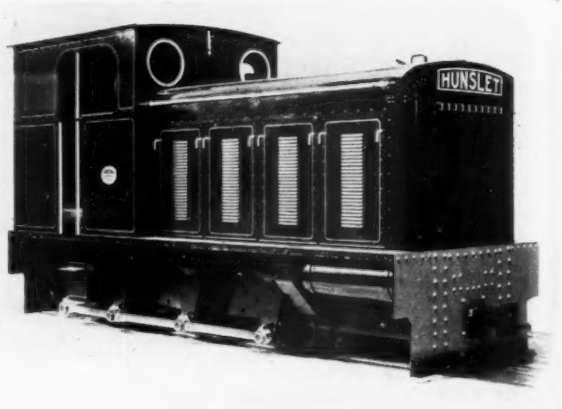
AN order of more than usual interest has been completed by the Hunslet Engine Co. Ltd., with the shipping of a 150/165 b.h.p. diesel mechanical locomotive to the Sinai Mining Co. Ltd., a concern operating manganese mines in the Sinai Peninsula, literally miles away from anywhere. The chief operating problem, which alone has been responsible for the change over to diesel traction, is that of water. All the water has to be obtained from Egypt at a cost of approximately 4s. per ton, and the mining plant as a whole consumes 700 tons a month. With diesel traction it is hoped to reduce the total to about 150 tons a month, and on this item itself some £1,080 a year will be saved. Oil fuel is already shipped to the company's jetty for use in stationary diesels, so here again some saving will be made by avoiding shipments of coal.

The line is of 2 ft. 6 in. gauge and runs inland from the jetty for a dozen miles over exceptionally difficult and deserted country. From the railhead a ropeway runs a further ten miles to the mines and for service here a 20 h.p. Hunslet diesel locomotive has been sent out, and transported over the ropeway in a dismantled condition. In the direction of the load, *i.e.*, down to the coast, the new Hunslet 150/165 b.h.p. locomotive has to haul a trailing load of 225 tons up a grade of 1 in 65, and on the return journey 58 tons of empties up a grade of 1 in 22 having a curve of 100 ft. radius.

Of the 0-6-0 type, the locomotive follows standard Hunslet design, as applied to the L.M.S.R. shunters. Due to the narrow gauge, the locomotive frames are outside the wheels and the drive is transmitted from the jackshaft at the rear end to the flycranks on the axles through rods. The wheels are 3 ft. in diameter and are spread over a base of 8 ft.; the total length of the locomotive is 21 ft. the height 11 ft. 4½ in., and the width 7 ft. 6 in. The Westinghouse air brake equipment includes a self-lapping valve; it is supplemented by a hand brake, and blocks on all wheels are applied by both methods. Gravity sanding is fitted to the leading and trailing treads. The whistle is operated from an air circuit and reservoir of its own. The cab has been designed to suit the tropical conditions, and is provided with a double roof, and with louvres which can cover completely the side openings. A set of driving controls (throttle and change-speed handles, reversing lever, pre-selective lever, and air brake handle) is fitted on each side of the cab, and indications are given of the temperatures of the cooling water, lubricating oil, and lubricating oil of the starting engine; air pressures for the brake; engine revs. and road speed; and the particular gear which is engaged.



150/165 *b.h.p. McLaren-Benz engine as used in the Hunslet diesel locomotive*



165 *b.h.p. diesel-mechanical locomotive built by the Hunslet Engine Company for service in the Sinai Peninsula*

Motive power is provided by an eight-cylinder McLaren-Benz engine developing 150 b.h.p. at 1,000 r.p.m. continuously and 165 b.h.p. as a maximum. This unit is the same as that fitted to one of the L.M.S.R. shunters, and was described in the issue of this Supplement for April 19, 1935. It is fitted with two four-ram C.A.V.-Bosch fuel pumps, and a fuel filter of the same make. Two large Vokes filters of the Protectometer type are provided on the suction pipe to strain the sand-laden air. Water and lubricating oil are cooled in a Serck sectional radiator mounted on the front of the bonnet, the elements of which are cooled by air drawn through by an engine-driven fan. The silencer is in three sections, with expansion joints between. Engine starting is effected by a Scott two-cylinder petrol engine and Bendix gear of a robust type, which are totally enclosed and mounted on a special welded steel frame. Air for the brakes and whistle is supplied by a Broom & Wade compressor driven by a belt from the main engine.

The four-speed mechanical transmission incorporates the Hunslet patent friction clutch with Ferodo lining and pre-selective change-speed gear of the type which has given good results on the L.M.S.R. and elsewhere. The gear-box shafts run in Ransome & Marles roller bearings, and with normal engine revs. the gears give respective speeds of 4, 7½, 12, and 20 m.p.h. The normal maximum tractive effort is 12,000 lb., but an effort of 13,140 lb. can be exerted at the rims with maximum engine power. The latter figure gives an adhesion factor of 3·8 against the working order weight of 22½ tons.

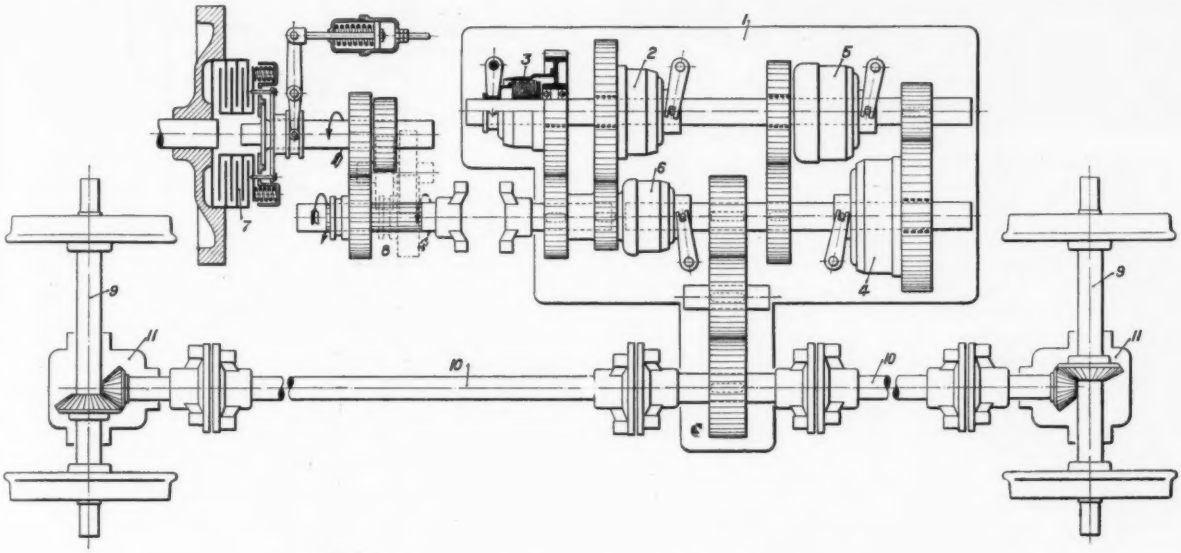
ORDERS FOR SMALL DIESELS.—The Hunslet Engine Co. Ltd., has in hand a 150 b.h.p. diesel locomotive with Ruston engine for service on the Gold Coast, and also several 37 b.h.p. units for the Kut barrage scheme and for West Africa.

EFFICIENCY TESTS OF MECHANICAL TRANSMISSION

Bench and road experiments on Ganz five-speed set

By V. LEHEL

A SERIES of tests to obtain the efficiency of the mechanical transmission built by Ganz & Co. Ltd., has recently been carried out at Budapest. The transmission gears investigated were of the type specially developed by Ganz for railcar purposes. The main feature in this transmission is a gear box of the constant-mesh type (Fig. 1) having individual friction clutches for each speed. One of each pair of constant-mesh gears is keyed fast to its shaft while the other gear runs loose. This latter gear can be fixed to the shaft by means of a multiple disc friction clutch. The clutches are brought into action by compressed air cylinders, operated by means of a master valve in the driver's cabins from either end of the car, thus ensuring extreme convenience of control and perfectly clash-proof gear shifting. A dry disc friction clutch of somewhat greater dimensions than those inside the gear box and capable of taking up the necessary slip at starting is built into the flywheel of the engine. Following this a spur-gear type reversing gear is inserted between flywheel clutch and transmission gear box. From the gear box the drive branches to the two driving axles which are driven through propeller shafts by means of bevel gear final drives.



1. Gear box.
2–6. Friction clutches for gear shifting.
(In 1st speed clutches, 2 and 4 are engaged.)
(In 2nd ,, ,, 3 and 4 ,,)
(In 3rd ,, ,, 2 and 5 ,,)
(In 4th ,, ,, 3 and 5 ,,)
(In 5th ,, clutch 6 is engaged.)
7. Dry disc friction clutch.
8. Reversing gear.
9. Driving axles.
10. Cardan shafts.
11. Bevel gear final drives.

Fig. 1.—General arrangement of Ganz five-speed mechanical transmission

In order to measure the efficiency of this transmission, two complete bogies of a 220/275 b.h.p. railcar were erected in the test department. With the exception of the engine these bogies were fitted complete,with the mechanical transmission above described ready to work in a railcar. The arrangement was such as to give the closest possible imitation of actual working conditions in railway service.

The method employed was in principle an electric version of the method generally known as the Daubresse-Vinçotte test, frequently used in testing gear drives. In the above-named test the primary and secondary shaft ends of one of the gear drives are connected through comparatively long elastic shafts to the corresponding shaft ends of the other gear drive, the elastic connecting shaft being mounted under an initial torsional stress, equal to the torque resulting under the load at which the efficiency should be measured. Thus the same tooth pressures and bearing loads will result as in actual working, neglecting the difference of the torque caused in running by the torque of the losses. Thus if the whole assembly is driven by some outside motive power, the amount of such power needed is only that required to cover transmission losses in the gear drive.

Owing to the fact that the primary and secondary shafts in the power bogies of the railcar in question are arranged at right angles to each other it was not possible to adopt this method without modification for testing two bogies and another method had to be contrived. In the method actually employed, as may be seen from Fig. 2, the two bogies were placed side by side with their wheels lifted clear of the rails and their axles connected by rubber disc flexible couplings through a short floating shaft. The bogie in the foreground of the photograph obtained its drive from the d.c. motor marked " Motor I " in Fig. 2 through a shaft provided with flexible joints exactly as if it were driven by the engine. The drive was transmitted through the entire transmission gear to the driving axles, and from these it passed to the second bogie where the drive was taken again through the complete transmission.

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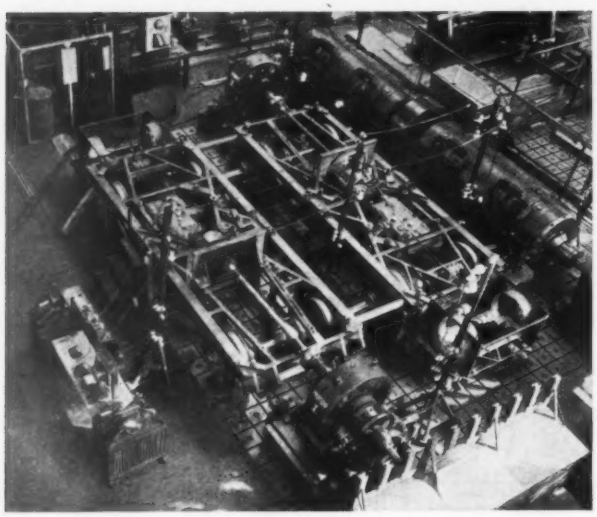


Fig. 2.—Arrangement of the two power bogies for the efficiency tests

In the place of the engine of the second bogie a d.c. dynamo marked " Dynamo II " on the photo was substituted, and functioned as a brake, taking up the power of the motor through the transmission gear of the two bogies.

As may be seen from Fig. 3, the dynamo was coupled to the driving motor in such a way as to return the current generated in the dynamo to the motor. Thus the amount of current supplied to the whole system was only that needed to make up for the mechanical and electrical losses of the entire assembly.

To simplify measurements and calculations, and thus to reduce the possibility of errors, direct current was adopted. The procedure consisted of measuring the energy introduced into the whole assembly. Iron and friction losses were ascertained at three speeds, viz., 900, 1,200 and 1,400 r.p.m., separately for the dynamo and for the motor.

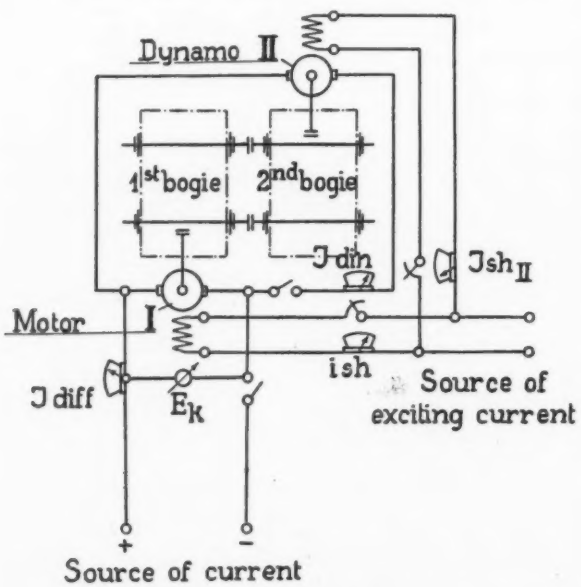


Fig. 3.—Diagram of connections between motor and dynamo during the tests

The armature losses and the auxiliary-pole losses, *i.e.*, the losses connected in series and, accordingly, the copper losses, were known from measurements of resistance. The shunts were fed during the tests from an outside source and thus it was not necessary to take their losses into account. The brush voltage drop was taken into account with the usual value of 1·5–2 volts. The load losses of the electrical machines were ascertained in differential connections, Fig. 4, by means of load measurement, in such a manner that the shafts of the two machines were mechanically direct-coupled. In this differential connection, the losses corresponding to the internal voltage drop, the friction losses, the copper losses, and the brush losses, were subtracted from the amount of energy introduced,

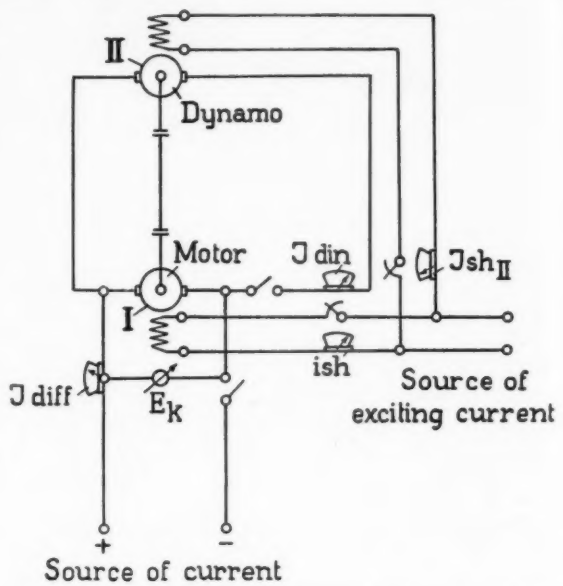


Fig. 4.—Differential connections to ascertain the load losses in the electrical machines

the load losses being obtained as the difference remaining. Also a series of measurements was carried out to define precisely the errors of the instruments used.

The characteristic curves of the motor and dynamo being thus known, the losses of the transmissions were calculated as follows :

If kW_m denotes the energy led into the motor, in kW.
W_m ,, the motor losses, in kW

then the effective output of mechanical energy of the motor is :

$$kW_{m\ eff} = kW_m - W_m$$

further, if

$W_{tr\cdot I}$ is the sum of mechanical losses in the 1st bogie
$W_{tr\cdot II}$,, ,, ,, ,, 2nd ,,
and W_d denotes the losses of the dynamo, then the total of losses in the entire assembly is :—

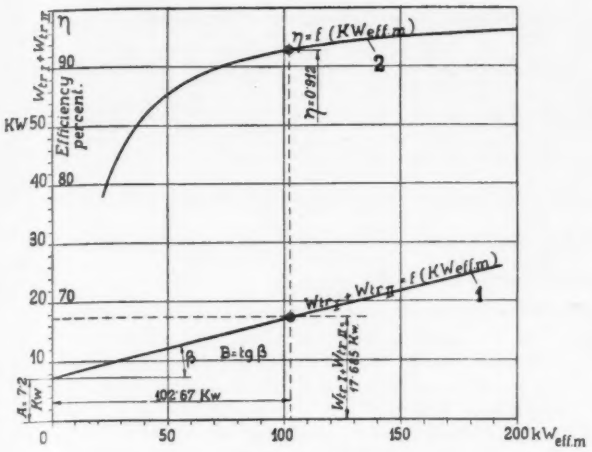
$$kW_\Delta = E_k \cdot I_{diff} = W_{tr\cdot I} + W_{tr\cdot II} + W_d + W_m$$

and

$$W_{tr\cdot I} + W_{tr\cdot II} = kW_\Delta - (W_d + W_m)$$

where E_k is the terminal voltage read on the voltmeter E_k, and I_{diff} is the current supplied to the assembly, read on the ammeter " $I_{diff.}$ " (Fig. 3).

If the actual figures of $W_{tr\cdot I} + W_{tr\cdot II}$ are plotted against the effective output of the motor, *i.e.*, the $kW_{m\ eff.}$, it may be seen that the relation between $kW_{m\ eff}$ and the



Curve 1, total of losses in both bogies.
Curve 2, efficiency of 1st bogie.

Fig. 5.—Curves to give the efficiency at 900 r.p.m. with the gear in fourth speed

bogie losses is linear, *i.e.*, the bogie losses can be defined by a linear equation :—

$$W_{tr\cdot I} + W_{tr\cdot II} = A + B\,(kW_m - W_m) = A + B\,kW_{m\ eff}$$

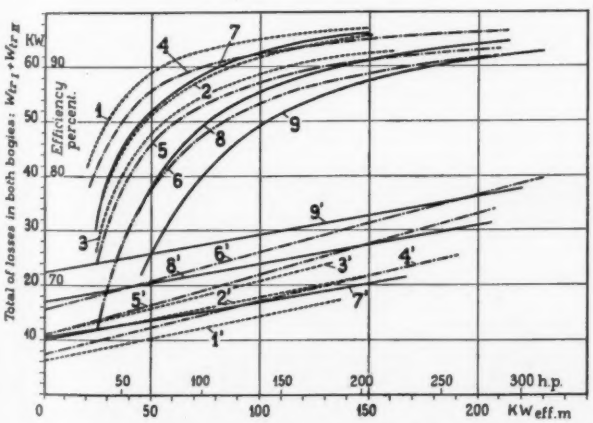
where A and B are coefficients which may be directly obtained from the diagram of losses (Fig. 5).

Though it has not much influence on the final results, it may also be considered that as the first bogie absorbs some of the output of the motor, the second bogie has actually to transmit less power than the first one. In order to attain higher precision this should also be taken into account. Supposing that each bogie absorbs the same amount of energy under the same load, the actual power loss in each bogie can be figured out in a simple way.

$$W_{tr\cdot I} = a + b\,kW_{m\ eff} \quad \ldots\ldots (2)$$

$$W_{tr\cdot II} = a + b(kW_{m\ eff} - W_{tr_I}) \quad \ldots\ldots (3)$$

$$= a + b(kW_{m\ eff} - a - b\,kW_{m\ eff}) =$$



Efficiency curves			Curves indicating total of losses in both bogies		
1.	3rd speed at	900 r.p.m.	1^1.	3rd speed at	900 r.p.m.
2.	„ „ „	1,200 „	2^1.	„ „ „	1,200 „
3.	„ „ „	1,400 „	3^1.	„ „ „	1,400 „
4.	4th „ „	900 „	4^1.	4th „ „	900 „
5.	„ „ „	1,200 „	5^1.	„ „ „	1,200 „
6.	„ „ „	1,400 „	6^1.	„ „ „	1,400 „
7.	5th „ „	900 „	7^1.	5th „ „	900 „
8.	„ „ „	1,200 „	8^1.	„ „ „	1,200 „
9.	„ „ „	1,400 „	9^1.	„ „ „	1,400 „

Fig. 6.—Efficiencies and losses of both power bogies at various loads and speeds

$$= a - ab + b\,(1\text{-}b)\,kW_{m\ eff}$$

From (2) and (3) :—

$$W_{tr\cdot I} + W_{tr\cdot II} = 2a - ab + (2b - b^2)\,kW_{m\ eff} =$$
$$= A + B\,kW_{m\ eff} \quad \ldots\ldots (4)$$

As may be seen from equation (1).

The equation (4) is satisfied if

$A = 2a - ab$, and $B = 2b - b^2$, from which

$$b = 1 - \sqrt{1\text{-}B} \quad \ldots\ldots (5)$$

$$a = \frac{A}{2 - b} \quad \ldots\ldots (6)$$

Using the equations (2) and (3) with the known values of a and b, the losses accruing to each bogie $W_{tr\cdot I}$ and $W_{tr\cdot II}$ are obtained.

The efficiencies will therefore be :

$$\eta_{\ tr\cdot I} = 1 - \frac{W_{tr\cdot I}}{kW_{m\ eff}} \text{ for the 1st bogie}$$

$$\eta_{\ tr\cdot II} = 1 - \frac{W_{tr\cdot II}}{kW_{m\ eff} - W_{tr\cdot I}} \text{ for the 2nd bogie.}$$

The actual values of efficiency obtained from the measurements are also shown in Fig. 5.

The following example serves as an explanation of the calculations set forth above in conjunction with Fig. 5 :—

Engine speed, $n = 900$ r.p.m. Gear in 4th step.

Instrument readings :

$E_k = 805$ volts ; $I_{dyn} = 97{\cdot}7$ amp. ; I_{diff} 40·6 amp.

I motor $= I_{dyn.} + I_{diff} = 138{\cdot}3$ amp.

kW introduced $= E_k.I_{mot} = 111$ kW.

Sum of internal ohmic resistance of motor :

$R_{mot} = 0{\cdot}11645$ ohm. (from preliminary tests).

Voltage drop at brush 2 volts.

E internal $= E_k - I_{mot}\,\Sigma\,R_{mot} - 2$ volts $= 787 - 2$	785 volts.
Motor iron loss at E internal (from preliminary tests)	4·92 kW
Motor copper loss $I^2_{mot}\,\Sigma\,R_{mot}$	2·24 kW
Brush loss	0·27 kW
Load loss (from preliminary tests)	0·90 kW
Total of motor losses, W_m	8·33 kW

Sum of internal ohmic resistance of dynamo, $R_{dyn} = 0{\cdot}1144$ ohm. (from preliminary tests).

Internal voltage drop : E int. $= E_k + I_{dyn}\,\Sigma\,R_{dyn} + 2v =$	818·2 volts
Dynamo iron loss at E int. (from preliminary tests) ..	4·74 kW
Dynamo copper loss $I^2_{dyn}\,\Sigma\,R_{dyn}$	1·10kW
Brush loss	0·195 kW
Load loss (from preliminary tests)	0·55 kW
Total of dynamo losses, W_d	6·585 kW
$W_m + W_d = 14{\cdot}915$ kW	
$kW_\Delta = E_k.I_{diff}$	32·60 kW
$W_m + W_d$	14·915 kW
$W_{tr\cdot I} + W_{tr\cdot II}$	17·685 kW

This equals the total loss in the transmissions of both bogies and it is plotted against the $kW_{m\ eff}$ as shown in Fig. 5.

$$kW_{m\ eff} = kW_m - W_m = 102{\cdot}67 \text{ kW.}$$

To define the losses accruing to each individual bogie the values of A and B may be taken from Fig. 5.

$A = 7{\cdot}2$ kW.

$B = tg\beta = 0{\cdot}102$.

Substituting these into equations (5) and (6) :

$$b = 1 - \sqrt{1 - 0{\cdot}102} = 0{\cdot}052$$

$$a = \frac{7{\cdot}2}{2 - 0{\cdot}052} = 3{\cdot}70$$

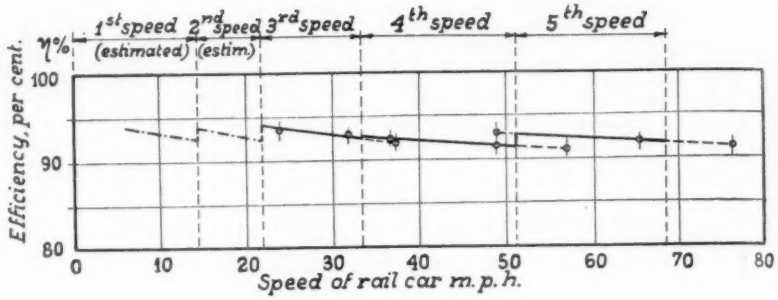
$$W_{tr_I} = 3{\cdot}70 + 0{\cdot}052 \times 102{\cdot}67 = 9{\cdot}04$$

The efficiency of the first bogie will be :

$$\eta_{\ tr\cdot I} = 1 - \frac{9{\cdot}04}{102{\cdot}67} = 0{\cdot}912$$

The results of the measurements have been collected

Fig. 7.—Efficiency curves of mechanical transmission as a function of the road speed. From calculations and tests made on the Ganz 275 b.h.p. express diesel railcars



in Fig. 6, and show the total of losses for both bogies at various loads for 900, 1,200 and 1,400 r.p.m. in 3rd, 4th, and 5th speeds. The torque on the driving axles in the 1st and 2nd speeds would have meant excessive stresses for the floating shafts connecting the axles of the two bogies; therefore no measurements were made in these two speeds, but studying the characteristics shown in the above diagram it will be evident that the efficiency at these two speeds certainly cannot be less than in the case of those speeds actually investigated.

This diagram shows that a certain amount of the losses is independent of the load, and the total of losses rises only slightly with the increase of the load. The losses are, however, greater in the higher gears and in each individual gear losses increase with the number of engine revolutions. Accordingly, the efficiency curves also show a rising tendency at higher loads, and reduction of the motor revolutions also results in the rise of efficiency.

As may be seen from Fig. 1 there are altogether four pairs of meshing gears in series in direct speed ahead and five in direct and reverse, while in the intermediate speeds the power passes through six pairs of gears when going forward and through seven pairs when going backwards. Assuming the efficiency to be about 99 per cent. for each pair of case-hardened and ground gears and about 97 per cent. for the case-hardened and non-ground bevel gears of the final drive, the total loss from the engaging gears alone may be about 6 to 8 per cent., which leads to the conclusion that the losses other than those resulting from the gears proper, such as oil churning and the friction of the loose discs of the disengaged clutches may not amount to more than 1 or 2 per cent., and they can therefore be entirely disregarded.

More interesting from the point of view of railway traction is Fig. 7, which illustrates the efficiency of mechanical transmission as a function of the speed of the railcar, assuming that during acceleration the engine always develops its maximum torque. The vehicle taken as a basis for this calculation was the Ganz 275 b.h.p. express railcar which maintains a daily service between Budapest and Vienna. The engine is designed to run at 1,250 r.p.m. as a maximum and the gear ratios are such as to give the following speeds with normal engine speed:—

1st speed	..	..	14·3 m.p.h.
2nd ,,	..	..	21·9 ,,
3rd ,,	..	..	33·3 ,,
4th ,,	..	..	51·1 ,,
5th ,,	..	..	68·3 ,,

It may be seen from Fig. 7 that the efficiency is practically constant at all speeds at about 93 per cent.

To check the value of the efficiency of the mechanical transmission on which the test bed measurements were made, acceleration tests were made with a railcar fitted with a transmission gear of identical design. The tests were carried out on a known track with an engine the output of which was exactly known from trials carried out in the test room shortly before acceleration tests were made on the railway. The gross weight of the car was measured before the acceleration tests, and its running resistance was also ascertained by previous trials. To check the results the acceleration was also defined by calculation where the engine power actually available for traction was calculated with the values of efficiency shown in Fig. 7.

In addition to the losses in the transmission the power consumed by the auxiliary machines, such as the lighting dynamo, brake air compressor, and engine cooler fan had to be taken into account. The power needed by these was also ascertained previously by tests and it was subtracted from the output of the engine.

As may be seen from the following table, the values obtained by calculation agreed fairly closely with the results of the actual acceleration tests:—

Speed, m.p.h.	Calculated		Measured at Acceleration Test	
	Time, sec.	Distance Covered, yd.	Time sec.	Distance Covered, yd.
12·4	7	21	8	No reading
24·8	28	219	28	197
37·3	58	712	60	766
49·7	110	1,810	112	1,860
62·1	195	4,020	200	4,000

Fig. 8.—One of the Hungarian 275 b.h.p. express railcars, the transmission efficiency of which is shown in Fig. 7